Journal of the Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

EDITED BY

R. G. HEBB, M.A. M.D. F.R.C.P.

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

J. ARTHUR THOMSON, M.A. F.R.S.E.

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FELLOWS OF THE SOCIETY

AND

A. B. RENDLE, M.A. D.Sc. F.L.S.   HAROLD MOORE, B.Sc.

Assistant in Botany, British Museum   *Woolwich Arsenal*

Minimis partibus, per totum Naturæ campum, certitudo omnis innititur quas qui fugit pariter Naturam fugit.—*Linnæus.*

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Fig. 3.

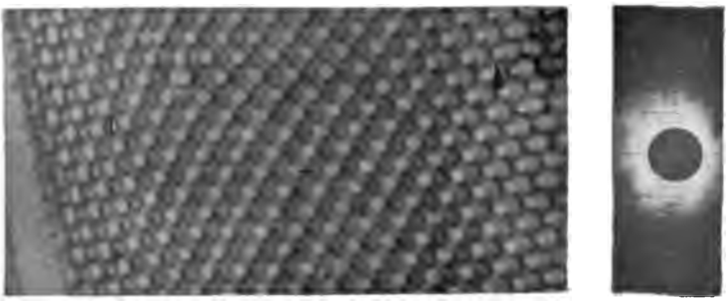

Fig. 2.

Fig. 1.

Fig. 1.—*Pleurosigma formosum* (mounted in balsam). Photographed by means of a narrow beam. S.A. = 0·35 *f* (N.A. = 0·35). Magnification 320 × 14 = 4480.

Fig. 2. - Same specimen, photographed by means of a broad beam, from which the centre is stopped out by means of a stop, of which S.A. = 0·35 *f*. The condenser beam is too much broken up in transmission by the diatom to be measured, but the W.A. appears to be about 0·8 *f*. The objective used has S.A. = *f*; (N.A. = 1). Thus, the image of Fig. 2 is complementary to that of Fig. 1.

Fig. 3. Same specimen, photographed by the same beam as Fig. 2, but without the stop. The image is visibly a blend of the images of Figs. 1 and 2.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY, 1907.

TRANSACTIONS OF THE SOCIETY.

I.—*The Use of a Top Stop for Developing Latent Powers of the Microscope.*

By J. W. Gordon.

(*Read November* 21, 1906.)

Plates I., II. and III.

In the course of the last session I had the honour of bringing to the notice of the Society a piece of apparatus designed to enable an observer to place a stop in the Ramsden circle of a Microscope, for modifying the illumination of the image formed by the instrument.* At that time, however, I could speak only as a matter of theory of what might be expected from the use of the instrument, the apparatus itself having been but a very short time in my hands. During the vacation I have found some opportunities of bringing it into experimental use; and in the hope that my results may be of some interest to Fellows of the Society, I have prepared a selection of photographs for submission to this Meeting.

Of the apparatus itself it is not necessary to give a detailed description here, seeing that the main parts of it have been both described and figured in the pages of the Society's Journal. These comprise a supporting collar, which can be clamped to the draw-tube of the Microscope, a screw-pillar carried by the collar, and supporting in its turn a stop-carrying arm and fine-adjustment mechanism for moving the stop over the top of the eye-piece, and holding it in any required position in the Ramsden circle. The stops which I have used are formed by minute

* See this Journal, 1906, p. 157; see also p. 365 for a diagram of the apparatus here in question.

globules of mercury mounted between two cover-glasses in Canada balsam, and the only addition which I have made to this apparatus —all of which, so far, has been already described—is that I have fitted upon the supporting collar a pierced platform, which forms a convenient support for an inspection lens when the stop has to be adjusted, and for a camera when a photograph is to be taken. Fig. 1 is a sketch of the complete apparatus, with an inspection lens in place, and fig. 2 is another sketch, showing my camera in position.

Before proceeding actually to discuss my photographs, I may, perhaps, say a word or two about the theory of this instrument as I understand it. It is, of course, quite commonly understood that in some way the image formed by a Microscope is dependent upon the illumination of the object itself, and that when fine detail is in question a better result may, as a rule, be secured by illuminating with a wide than with a narrow cone of light. Furthermore, it is perfectly obvious that when the stage of the Microscope is occupied by an object of high or low refractive index, the nature of the illumination is only in part dependent upon the angle of the incident beam. An objective of wide angle may be filled with light by the beam from a condenser of low angle if part of the light has been sufficiently deflected from its original course by reflection, refraction, or diffraction as it passes the stage of the instrument. Hence, when we speak of the illumination of an object in the Microscope, we mean the light received by the objective, not the light received by the object, for a very large proportion of the objects with which we are familiar illuminate themselves. Stained objects are almost the only exception. Even polished objects are not exceptions to this rule, for a highly-polished surface, to be visible at all, must be placed at an angle to the plane of the stage, and then it deflects the incident light in such a way as to be distinguishable from the field by the different angle at which its light crosses the optical axis—that is to say, it is in an optical sense self-luminous. While polished objects thus become effectively self-luminous by reflection, transparent objects become visible, when visible at all, by refraction of the light which they transmit. This refraction makes them self-luminous in the same sense, for a new ray, not to be found in the light from the field, starts from such an object as its point of origin. And even stained objects—among which I include such as show by simple opacity—may become self-luminous if they exhibit the phenomena of repetition, for any form of ruled surface produces diffraction along certain axes, and the diffracted light so originating behaves exactly like reflected or refracted light of equal intensity in the formation of the image. Thus in determining the illumination of an object, the behaviour of the objective is, as a rule, of greater importance than that of the condenser, for in most

cases the condenser beam is powerfully supplemented by rays in some or all of these different ways originating in the object itself.

It is easy thus to advance to a perfectly clear idea of what we mean by illumination under a wide angle, but having done so, we find that the next step lands us in uncertainty. For it is most natural to ask concerning the broad wave-front built up in this way of elements derived from the condenser and of other elements

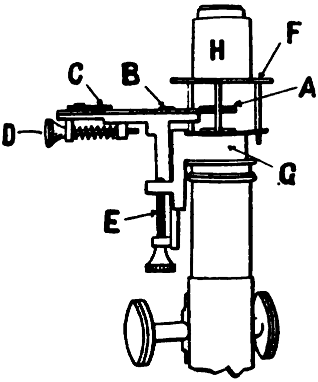

FIG. 1.

Top stop fitting, with an inspection lens in position. A. Loose cell for carrying the stop. B. Pivot on which the cell carrying arm swings. C. Excentric for swinging the arm to cause the stop to traverse the beam in a transverse direction. D. Propelling screw for causing the stop to traverse the beam in the fore and aft direction. E. Supporting screw for adjusting the height of the stop. F. Removable gallery for carrying the inspection lens (or camera). G. Ring for mounting the fitting upon the draw-tube of the Microscope.

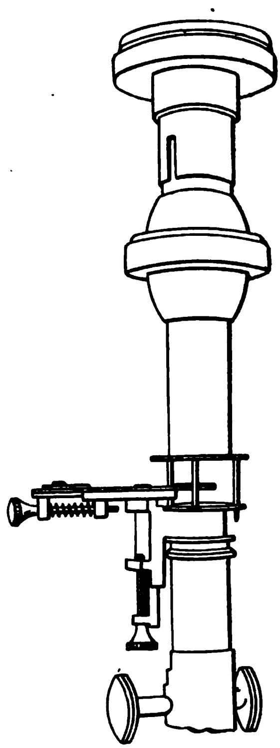

FIG. 2.

Top stop fitting, with camera in position on the gallery.

supplied by the object: Is it an individual thing having properties different from the properties of its parts, or is it only an aggregate endued with the total of all the properties which are proper to its various constituent parts? The question suggests a distinction like that between a mixture and a compound in chemistry. A molecule, which consists of atoms of oxygen and carbon, is an individual thing having chemical properties wholly unlike those of

its constituent atoms. It will not react as they do, and on the other hand it has new capabilities of which they do not even possess the promise or potency. In contrast with this, a drop of water and hydrochloric acid mixed is simply dilute acid or acidulated water, which you please. It will oxidise as the water does, or chlorinate as the acid does, and exhibits no original properties. It only reacts less actively than its components because each of them attenuates the other.

Now which of these cases illustrates the case of a wave-front built up, as I say, from rays received from the condenser and other rays originating in the object? This is, so far as I know, a matter which still awaits investigation, and it is one upon which, if I mistake not, my photographs this evening will have a bearing. But before going to the photographs, let me invite you for a moment to consider the importance of this theory of the broad-angled wave-front to the theory of the Microscope.

Every wide-angled beam contains, of course, a narrow-angled beam at its core. If by means of a diaphragm we cut off an outer annulus from its margin, we leave the beam of narrower angle standing. Now we know very well that the narrow cone thus cut from a beam of larger angle has all the vices of the narrow beam. No surviving virtue distinguishes it from the ill-bred beam which never shared in the achievements of wide angles. What ought we to think of its contribution to the entire result which was reached when it formed the central part of a greater whole? Did it act simply as a diluent, attenuating the virtue of the annulus with which it was so associated, like the water of the dilute acid, or was it, like the atom of a compound molecule, an indispensable component contributing according to some inscrutable law to the corporate individuality of the whole?

Now it may turn out that the further advance of microscopy will depend largely upon the answer to this question. For, if this narrow-angled core is an indispensable constituent of the wide-angled beam, we cannot improve our instruments by suppressing it. But if, like the diluent in a weak solution, it only weakens the action of the remaining constituent, then there is a chance of great advance in the resolving power of our instruments, for, hitherto, our widest beams have been allowed to work only under the trammels of indissoluble association with beams of narrow angle. The question is, can we emancipate the wide-angled cone from narrow-angle tyranny, or is it the true view that both wide and narrow must co-operate to produce the perfect picture?

Having stated the question, I will leave the answer to my photographs, but still will ask leave to interpose one or two remarks in explanation of the method which I have followed in producing them.

My object, as you perceive, has been to ascertain by experiment

whether it is or is not possible to improve the performance of a given objective by suppressing its centre, and I have therefore made no attempt to work with objectives of high power. On the contrary, the lens with which I have worked is an oil-immersion of N. A. = 1, the narrowest angle to which oil-immersion lenses are made. It has not been practicable to go to lenses of lower magnifying power, because the scale of my original negatives is, as matters stand, very inconveniently small. It unfortunately happens that a railway tunnel runs within fifty yards of my street door, and about once in every five minutes through the day and the working night an earthquake shakes the house from attic to basement. My best chance of getting a photograph at all is to cut in between the earthquakes, and therefore I have to be content with short exposures. Short exposures, when a top stop reduces the image-forming beam to a mere edge, imply low magnification, and thus it happens that all the photographs which I have to show this evening are enlargements from negatives of about 300 diameters magnification. So much for the lens employed.

As to the illuminant, I have used a Welsbach mantle and a yellow screen. The Welsbach mantle, thrown far enough out of focus to destroy the image of the mesh, gives a very excellent light, quite strong enough for my purpose. A pin-hole aperture placed between the condenser and the lamp, and situated in the conjugate focus of the condenser, cuts off superfluous light and confines the illumination to the area under observation. The yellow screen, employed with an orthochromatic plate, enables me to photograph what I see—a consideration sometimes overlooked by photomicrographers. A superstitious belief in the superior virtue of blue light leads them to use ingeniously-devised blue screens, with the result that if they obtain sharp images at all, they so obtain images of such things as the eye hath not seen, for under these conditions a human eye sees one thing, and a photographic plate sees another. The residual yellow limns one plane in the eye, the ultra-violet sketches a higher plane in the camera, and if these two planes in the object carry different designs —as commonly they do with high-power objects—the result of an exposure is unintelligible to the mere photographer, and exasperating even to the most chastened microscopist. To spare myself these vexations I use, both for focusing and photographing, a strongly yellow light.

For my purpose a plate of very fine grain is of course indispensable, since my negatives are destined to undergo extreme enlargement. I therefore use an orthochromatic process plate, and as such plates are to be had which are much more rapid than ordinary process or lantern plates, the highly important condition which enables me to work with comparatively short exposures is also satisfied.

It may, perhaps, be thought that I have handicapped my apparatus by making use of yellow light. For, it will be said, is it not the fact that the resolving power of blue light is greater than that of yellow light in a proportion which approximates 2 : 1? Now, as a matter of speculative theory that is true, but for practical purposes it is unimportant, for no lens at present made goes anywhere near the wave-length limit of resolving power in its performance except upon ruled gratings. Lord Rayleigh, in a paper published in the Journal of this Society in 1903,* drew the distinction, and showed that whereas $\frac{\lambda}{2 \sin u}$ is the limit of grating interval which can be resolved in a uniformly ruled surface, a single dark line lying in a wide bright field is theoretically visible if it has a breadth equal to one-fourth of this magnitude, or under very favourable conditions of illumination equal to as little as $\frac{1}{16}$. For the case of an isolated black dot, the calculations have not yet been made, but it will probably be found that a dot is theoretically visible even when its diameter is less than that of the narrowest visible dark line. Now it so happens that dark lines and dark dots in a bright field are the most important of all forms to the practical microscopist, for they are the forms which bacteria assume. We may, therefore, be well content to confine our attention for the present to the work which can be done with vivid yellow light. This evening I hope to satisfy you of this, among other things, that the undeveloped resources of yellow light are so vast that it is not only possible and pleasant, it is as wise as it is pleasant, to put by the blue screen for a time and see what can be done by examining objects which it is perfectly easy to see.

The first of such objects which I have to submit to your notice is a *Pleurosigma formosum*, photographed under three conditions of illumination (plate I.). In fig. 1 it is imaged by a narrow beam of light, having a semi-aperture equal to one-third of its focal length (N.A. = 0·33). In fig. 2 it is imaged by a hollow cone, having a semi-aperture of 1·3*f* (N.A. = 1·3), from the centre of which the first-mentioned cone has been stopped out; and in fig. 3 it is imaged by the full solid cone, of which the two preceding are component parts, having S A. = *f*, that is to say, N.A. = 1.

A comparison of these three figures suggests many interesting conclusions. In the first place, the contrast between figs. 1 and 2 is very striking. The dot, which is densely black in the one, is brilliantly white in the other, and the field which in fig. 1 is featureless, is covered in fig. 2 with delicate markings. The significance of this is quite unmistakable. The dot is, clearly, a region in which the incident light is strongly refracted at the surface of the diatom. It is thus thrown towards the edge of the

* See this Journal, 1903, p. 474.

beam, and when that edge is cut off by the diaphragm interposed in the optical system which produces fig. 1, the dot is accordingly darkened—that is to say, it is darkened by the diaphragm. Moreover, it is darkened in so much greater measure than the field that it shows up as a black dot. But when the stop is introduced in the system of fig. 2, the refracted light from the dot in the diatom passes round it, suffering very little diminution, and the dot itself appears accordingly as a bright object in a dark field, for the unrefracted field light is sensibly diminished by the stop.

The explanation of the delicate tracery upon the field of fig. 2 is similar. The surface of the diatom is not a true plane like a piece of optically-wrought glass, but an undulating surface like the surface of bottle-glass. Hence, slight refractions are produced at every point, and these vary from point to point the capacity of the emitted light for passing round the stop, and so give rise to these exquisitely delicate indications of structure. This view of the function of a stop in exhibiting the most delicate forms of diaphanous structure was originally put forward, so far as I am aware, by Töppler, and may be found very clearly explained in his paper on the subject in Poggendorf's "Annalen" for the year 1867.*

If, now, you examine fig. 3, you will observe that it is a blend of figs. 1 and 2, but it is a blend in which the distinctive features of each are weakened by the admixture of the other. Thus the tracery has almost disappeared from the surface of the diatom, and the black dot has lost solidity and acquired a faintly bright centre.

In this case, then, the answer to the question just proposed appears to be undoubtedly that the wide-angled annulus and the narrow-angled core mix, but do not combine their powers, in the full-beam picture. If we want to see all that the wide-angled component of this beam can reveal we must suppress the centre; and on the other hand if we want to study the picture limned by the centre of the lens we must cut off its margin. Perhaps it will be thought that this last remark is not worth making. And indeed it is obvious that the angle of any lens can be cut down by a diaphragm. But what is worth pointing out in this connection is that the picture obtained from a narrow beam has a value of its own. Too much, or at least too exclusive, attention has in recent years been devoted to the merit of wide-angled lenses, so that probably it will savour of paradox if I presume to say that the one picture is a useful and in some cases a necessary supplement to the other. And as that is what I desire to say this evening I propose to entrench myself in fig. 1. Confessedly fig. 2 shows much more of the structure than fig. 1, and if we had to choose

* Pogg. Ann., cxxxi. p. 33.

one or the other it would undoubtedly be wise to choose fig. 2 in preference to fig. 1. But since we can have both, both are worth having. For, to instance one point only, in discussing the form of the dot it is important to know whether the light which it transmits is all refracted towards the margin of the aperture or evenly distributed over its area. Fig. 2 taken alone cannot answer this question. It tells you that a large proportion of the transmitted light is deflected to the outer annulus, but it cannot tell you whether any considerable proportion is left to follow a path closer to the optical axis. In a word, it cannot tell you whether the refraction is regular like that of a lens or irregular like that of a surface of ground glass. Still less can it afford you any information—even on the assumption that the refraction is regular—as to what the rule is to which it is subject. On these points fig. 1 affords decisive evidence. It tells you at once that no substantial quantity of light comes along the optic axis: therefore, the refraction is regular and the dot must have some simple geometrical form; and if you choose to vary the dimensions of the stop and of the aperture you may determine by the comparison of a number of pictures such as figs. 1 and 2, through what zones precisely the refracted light comes, and thus obtain what I may perhaps call a stop analysis of the transmitted light from which inferences may be drawn both as to the form and as to the refractive index of the structure in which the refracted rays originate. I must not, however, pursue this suggestion further, for I have other photographs to bring under your notice.

In plate II. fig. 4 you have a bright dot photograph of the familiar *Pleurosigma angulatum* taken with a small aperture, and exhibiting certain dark contours. The meaning of this appearance would be inscrutable if we were only able to vary the illumination by substituting a beam of wider angle for the narrow-angled beam, for although the wide-angled beam lights up these darkened areas, it causes them to present an appearance wholly indistinguishable from that of the other areas by which they are surrounded, so that in this instance the beam of wide angle is actually less discriminating than the narrow-angled beam.

The significance of this appearance is however made quite clear by altering the position of the small aperture in relation to the large beam. We thus find a region through which, if we examine the specimen, these particular areas appear bright while the others, bright in fig. 4, appear dark. This contrasted image is shown in fig. 5, which, however, is photographed from a direction less favourable to the resolution of the image than that from which it was viewed in fig. 4. It is manifest that the light transmitted by these parts of the specimen has been refracted along an inclined axis, which we have now identified, and we can at once conclude that the small surfaces which have pro-

duced this effect are tilted to one side relatively to the remaining surfaces of the diatom. It is not difficult to determine the angle of tilt necessary to produce the observed effect, and of course the orientation of the facets is given at once by the axis of the refracted beam. Thus we may obtain by means of a very simple operation of stop analysis an orographical representation of the surface, and so trace irregularities of contour which, being developed along the line of vision, are not to be seen except by oblique illumination, and require for their detection the peculiar discriminating power of the much-disparaged narrow aperture. As to the exact adjustment of aperture and stop employed in these experiments, I may refer you to the photograph of the Ramsden disk which is appended to every photograph. By means of such a photograph, and a scale such as is shown projected upon it, the exact adjustments used are accurately recorded. The scale, I may say, is, when fully divided, graduated to decimal subdivisions of the equivalent focal length of the Microscope taken as a whole. Thus, if the magnifying power is 1000 diameters with a camera focal length of 10 in., the scale unit is $\frac{1}{100}$ in. and the degrees inscribed upon it are $\frac{1}{1000}$ in. each. In figs. 4 and 5, however, the scale is too small for useful subdivision, and the graduations stand at distances equal to f apart. The photographs, being enlargements, show both the Ramsden circle and the scale itself of proportionately increased dimensions. It will, of course, be evident that this employment of the equivalent focal length to measure the aperture gives a systematic value to the readings. That is to say, all the apertures with which we are concerned are stated in terms of f. Photographers and astronomers unfortunately express their measurements in terms of the full aperture, not of the semi-aperture, and as an expression for the full aperture, that is to say, for double the diameter of the mean zone, would be almost unintelligible when used to denote the breadth of an annular opening I have not been able to adopt their notation. Microscope makers, on the other hand, although they employ the diameter of the mean zone for expressing the angle of a lens, speak of their readings under the superfluous and obscure name "numerical aperture," and pedantically suppress all reference to the conventional symbol f. This form of expression therefore, although it signifies exactly what I have done, is so little suitable for scientific use that I have hesitated to adopt it, and, choosing a middle course, have written my magnitudes thus: S.A. $= nf$; the letters S.A. denoting semi-aperture and the symbol n standing for the numerical coefficient which expresses the diameter of the mean zone in terms of the equivalent focal length—the value which lens makers call the numerical aperture. To translate this into the language of opticians generally, the numerical value must be doubled and the equation written $A = 2nf$, whereas it may be taken as it stands for numerical

aperture, reading N.A. for S.A., by those to whom this last mentioned form of expression is familiar.

In plate III. fig. 6 you have a photograph of *Pleurosigma angulatum*, of the familiar type, obtained with wide-angled lenses. Since it is familiar I need not enlarge upon its features. You will recognise the "white" dot growing up within the "black," which is a feature commonly employed as a test of the resolving power of a lens of N.A = 1·3. My lens of N.A. = 1 is, of course, quite incapable of yielding this picture, unless its effective aperture is increased by a central stop. The stop used to produce this particular image has, as you will see from the picture of the Ramsden disk, a semi-aperture of 0·2 *f*. But the observed effect cannot be attributed to this stop alone. The suppression of much of the refracted light, by interference due to diffraction, has the same effect on the image as a very large stop. In fact, the refracted light which escapes suppression in this way, all lies either in the narrow prolate central beam, or in the six divided beams which lie in an annulus around the margin of the Ramsden disk. This annulus has, in fact, a semi-aperture of 1·7 *f*, which is equivalent for the purpose of image formation to a N.A. of 1·7. The semi-aperture of the central beam is 0·8 *f* in the longer direction, and 0·45 *f* in the shorter. It will, of course, be obvious that the diameter of the mean zone of an annulus is greater than that of the mean zone of the circle which forms its outer boundary by a quantity equal to the diameter of the circle which forms its inner boundary. Thus, if we stop out the centre of a circular beam of light by means of a circular stop, we increase the angular value of what is left by a quantity equal to the angular value of the stop itself. It is thus possible to increase the numerical aperture of any given lens up to a limit which is equal to twice the aperture of the lens unstopped.

While pointing out the fact that we can, in this indirect way, increase numerical aperture, I desire to guard myself against being supposed to suggest that the mere increase of this function accounts for all the improvements which the stop introduces into the performance of the lens. The stop does much more than that. It reduces to a minimum the errors due to residual spherical aberration—a matter, if I mistake not, greatly more important than mere increase of angle. But it does also what is more important still, more important than the diminution of the spherical and diffraction errors taken together, that is to say, it gives us the means of so balancing the refracted and unrefracted light emitted by the object as to be able to render salient those features which we wish to observe. This is why an annular lens, tried and found wanting in the telescope, where it would be quite effective so far as mere corrections are concerned, proves to be of high value in the Microscope. You cannot voluntarily vary the lighting of the moon. If you want to measure the height of Tycho, you must wait for the

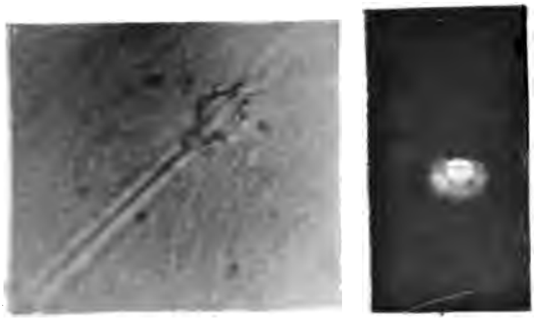

Fig. 5.

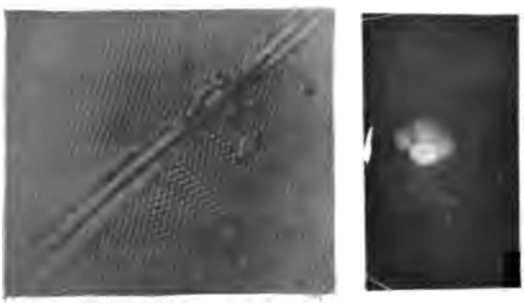

Fig. 4.

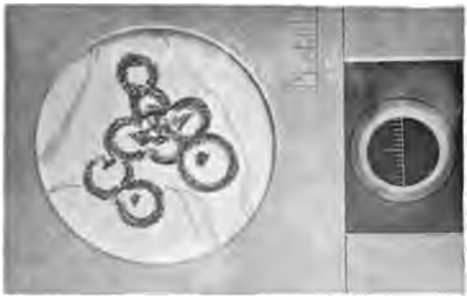

Fig. 8.

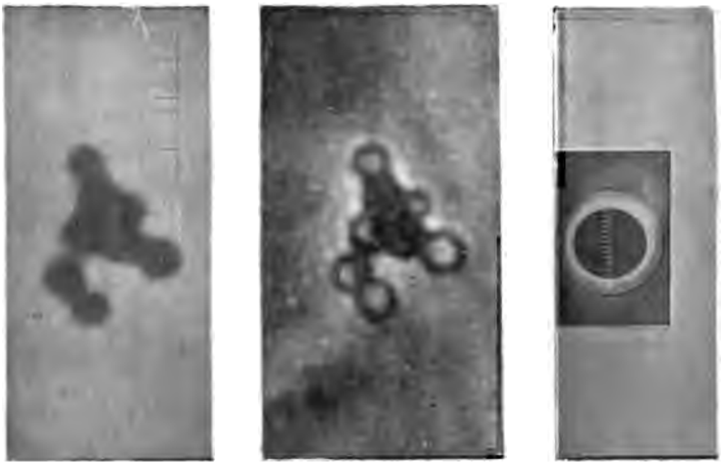

Fig. 7.

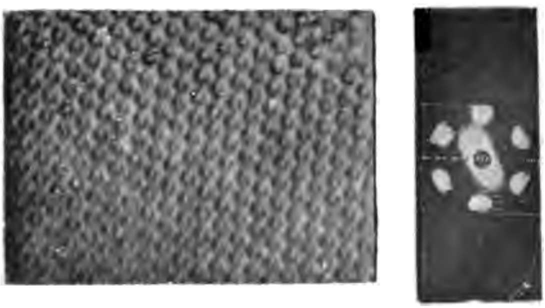

Fig. 6.

Fig. 6.—*Pleurosigma angulatum* (mounted dry), photographed by a divided beam. Condenser beam S.A. = 0·225 *f*; (W.A. = 0·225). Stop S.A. = 0·2 *f*. The annulus in which the six diffracted beams lie, has S.A. = 1·7 *f* (equivalent to N.A. 1·7). The central beam is unsymmetrical; thus S.A. = 0·6 + 0·2 = 0·8 in the long diameter, and S.A. = 0·25 + 0·2 = 0·45 in the short diameter. The image may be considered as a composite, in which regular images from these two sources are blended. Magnification 320 × 14 = 4480.

Fig. 7.—*Staphylococcus*. In the top panel as photographed by the beam shown in the marginal photograph, but without the stop. Condenser beam S.A. = 0·8 *f* (W.A. = 0·8). Objective S.A. = *f* (N.A. = 1). Magnification 314 × 20 = 6280. In the second panel the same specimen photographed by the same beam stopped as shown in the marginal photograph. Stop S.A. = 0·65 *f*. Condenser beam S.A. = (0·8 + 0·65) *f* = 1·45 *f* (equivalent W.A. 1·45). Objective S.A. = (1 + 0·65) *f* = 1·65 *f* (equivalent N.A. 1·65). Same magnification as before.

Fig. 8.—Sketch of the same specimen, the subject of Fig. 7. Illumination the same. Magnification the same.

exact phase when cross light throws one half of the mountain into shade, and its shadow on the moon's disk. With an object on the stage of the Microscope it is otherwise. You have command of its illumination, you can produce cross lighting at will, and invoke the precise phase that suits your immediate purpose. Furthermore, the top stop enables you to do this not only without sacrifice of angle, but with an actual increase of effective angle in your objective and consequently with undiminished resolving power.

I pass now to the last specimen with which I propose to trouble you this evening. Plate III. fig. 7 comprises two photographs of a specimen of *Staphylococcus*, taken, the upper one without, the lower with the aid of a top stop. Plate III. fig. 8 is a drawing of the same object, made for the purpose of exhibiting certain features too minute to be photographed with the low magnifying power, which, as already explained, I was constrained to use. The scale imposed upon the photographs reads in degrees of $\frac{1}{100000}$ in., and the marginal photograph shows the Ramsden circle with the stop in position.

The upper photograph exhibits nothing remarkable except the fact that the negative has stood perfectly well an enlargement of over twenty fold, for it will be seen that as here printed the picture has a magnification of nearly 7000 diameters. But, save for its large scale, it is precisely what most photographs of *Staphylococcus* are, a picture of little spherical masses of pigment accompanied by a very faint and vague indication of an enveloping sheath.

The second picture—formed by the stopped lens—is of a totally different character, and unless somebody else has been using a top stop, I imagine that no such detailed picture of a *Staphylococcus* has ever before been seen. The stop has a semi-aperture of $0 \cdot 65\,f$, and the objective annulus has accordingly a semi-aperture of $1 \cdot 65\,f$, and yields accordingly an antipoint of the dimensions which would be produced by a lens of N.A. $= 1 \cdot 65$, if such a lens could be made. But it is not the large angle of this combination which yields the remarkable detail of the second photograph. The resolving limit has in these pictures nothing whatever to do with the objective aperture, but is settled by the diffusion circle of the camera. Hence the necessity of a sketch to show the full resolution obtained. The stereoscopic representation is secured by selecting the stop and adjusting the condenser aperture so that the widely refracted light may show us the object under a large angle of observation.

There are here several points to which attention may be directed. Most remarkable of all is the very striking display in the second picture of the enveloping jelly—the sheath—which in the first picture is all but invisible. This sheath is generally to be seen in the images of bacteria formed by lenses of wide angle, but as a rule only as a bright edging to the outline of the object. It

is so in this case, and Mr. E. M. Nelson, who has been good enough to examine this particular specimen with a lens of N.A. = 1·3, estimates the edge so seen as having a thickness of $\frac{1}{40000}$ in. With my own lens unstopped the edge is barely discernible, and I am afraid that my photograph does not show it at all. But with the aid of the stop it is conspicuously visible, and it is not only seen as an edging: it is seen also, by virtue of the distortion which it introduces, as a transparent mass enveloping the coccus forms, and interposed between them and the eye. This is particularly observable at the actual centre of the picture. There are four cocci with a very small space between them, through which the field light shines. A full beam even of very wide angle shows this feature quite undistorted, as though the four cocci were lying in a homogeneous medium. But the annular objective shows these central cocci so much distorted by the refraction of the overlying jelly that they may be likened to grapes seen in the substance of a *gelée aux fruits.* The central space is hardly to be recognised, so broken is the light in passing through the envelope of highly refracting material. In fact, this particular adjustment of the illumination shows more of the sheath than of the coccus forms which it incloses.

And now I must ask you to observe what very high resolving power is here developed. In illustration of this point I might call attention to the photograph itself, where the individual coccus is seen outlined by a dark line that is less than $\frac{1}{100000}$ in. in thickness. But, as I have already said, my camera at the low magnifying power which I was using falls far short of the objective in this particular. I take, therefore, by preference, the sketch fig. 10. You will observe that here there is a minute speck seen upon each of the larger and more outlying cocci, not quite in its centre, but drawn a little towards the centre of the mass. These minute specks are quite sharply defined in the visual picture. What they represent I do not know. I suspect very much that they are optical phenomena and do not stand for any opaque mass in the specimen itself. But whatever they are, they are immeasurably small. Any estimate of their magnitudes must needs be vague, but it is a pretty safe estimate to write them down at something less than $\frac{1}{150000}$ in. To take for example the largest coccus. This measures, to the outside of the dark defining ring, a diameter of $\frac{1}{30000}$ in. If from this we deduct $\frac{1}{80000}$ in. for the double thickness of this dark ring, and take one-third of what remains for the visible diameter of this minute speck, we arrive at $\frac{1}{144000}$ in., and when you examine the specimen itself your eye will apprise you that one-third is a full estimate of the diameter of the speck as compared with the bright centre in which it lies. We thus get strong definition of an object whose dimensions were long supposed on authority no less than that of Professor Helmholtz, to be below

what could be rendered separately visible by any optical means whatever; and although the recent investigation of this subject by Lord Rayleigh has shown the question to be less simple than Helmholtz supposed, and the ultimate limit of resolving power an object very much smaller than he determined, still the matter rests at present in such a state that it is of interest to accumulate the experimental evidence of resolution that transgresses Helmholtz' rule. The top stop makes this an easy task.

It will, I hope, have been clear to you that the imperfections of the photographs by which I have sought to illustrate this subject are not due to want of effort on my part to provide something that would be worthy of your consideration, but to the somewhat hard conditions under which I have been compelled to work. My hope is that, with all their shortcomings, they will afford evidence sufficiently striking of what this new appliance may be expected to accomplish, when it gets into more capable hands than mine, to secure adequate consideration for what, if I am at all able to judge, are exceedingly promising lines both of theoretical research and practical advance.

NOTE.—The very unsatisfactory picture which stands as fig. 5 in plate II. requires an explanation and an apology. The small scale and a feeble negative explain its shortcomings. The reason why the scale is so small and the negative so feeble—which must stand for its apology—is that the making of a photograph of so small an object with a beam of so narrow angle is a task of considerable difficulty. For writing the text and for exhibition at the meeting I used prints made by direct photography. Had I realised how much the result would be deteriorated by photo-process reproduction, I would have chosen some bolder object. It is nevertheless possible to see in the picture, as it stands, that the higher edge of the mid-rib, for example, is dark in fig. 5 though bright in fig. 4. The original negatives are full of such contrasts.—J. W. G.

II.—*Microscopic Study of Strain in Metals.*

By F. Rogers.

Read December 19*th*, 1906.

Plates IV. and V.

Comparatively few workers have devoted themselves to the interesting study of the effects of stress upon metals by means of the Microscope, yet important work has been done by Ewing, Rosenhain, and Humfrey, by Stead, and by Stanton, in this country, and by Osmond, Frémont, and Cartaud, in France; the English workers having studied more especially the effects found in the ordinary forms of metals, and the French, with admirable pains, have worked upon abnormally large individual crystals of iron, and, in general, have regarded the subject from the crystallographic standpoint.

The author's studies about to be described have borne more particularly upon the fatigue of metals which is brought about by submitting them to alternating stresses. Previous to his work, all that was definitely known was due to Ewing and Humfrey, who found that in Swedish soft iron the process of fatigue consisted of a slipping backwards and forwards of some portions of the metal over others, along crystal cleavage planes, the grinding action gradually diminishing cohesion until fracture occurred.

In ordinary structural steels, which consist of a conglomerate of ferrite and pearlite, the effects are in some respects of a similar nature. Not only, however, are the effects in pearlite distinct from those in ferrite — owing to the probable absence of crystalline orientation in pearlite—but, on account of the local support given by the pearlite grains, the effects in the ferrite of steels are different from those in pure iron. Further, it will be seen that each variation of carbon content, and many variations of heat treatment of the steels, affecting as they do the proportions, arrangement, and nature of the two constituents, have a profound influence upon the manner in which repeated stresses gradually cause disruption of the metal.

It is almost natural at first glance to suppose that the incipient cracks in steel would tend to select a path through the weaker constituent, ferrite, avoiding pearlite as much as the arrangement of the two constituents in a particular sample admits. This con-

Fig. 5.

Fig. 1.

Fig. 3.

Fig. 1.—Steel A, annealed at 620° C. After 100,000 reversals of 19 tons per sq in. × 415.

„ 3.—Steel A, annealed at 900° C. After 75,000 reversals of 19 tons per sq. in. × 415.

„ 5.—Steel A, specimen 6. Heated after partial fatiguing. × 17·5.

clusion must not be accepted without careful examination, however, as there are several opposing circumstances. Thus, when submitted to strains of equal amount, it is probable that the stress in ferrite is about 10 p.c. less than that in pearlite. Again, the writer has elsewhere shown that on account of the difference between the coefficients of expansion of ferrite and pearlite, it is probable that there is an initial compression stress in the ferrite, and tension in the pearlite, of steel, which may in some cases amount to as much as 5 tons per square inch. A third consideration is, that those portions of incipient cracks which are seen to pass through ferrite probably meet pearlite grains beneath the ferrite, and may even have formed partly on account of the incipient cracking of the pearlite beneath. However, careful and wide study shows that there is a quite decided tendency to selection of a course through ferrite, which is no more exclusive than these reasons would lead one to expect.

The nature of strain effects in pearlite deserves notice. Varying as it does from slightly transformed microscopically homogeneous sorbite to definite alternate laminæ of ferrite and cementite, it is found that the incipient cracks in a pearlite of the former variety take indefinite and irregular courses, whilst in the latter the course is often along the plates—apparently through ferrite—occasionally directly across them through a whole pearlite grain, and sometimes step by step, first along ferrite, then across cementite, and so on.

The percentage compositions of the steels on which the main series of heat treatment and fatigue experiments were carried out, are shown in the following table:—

Steel.	C	Si	S	P	Mn
A	0·270	0·047	0·042	0·040	1·060
B	0·140	0·112	0·040	0·031	0·600
C	0·320	0·027	0·025	0·028	0·310
D	0·580	0·050	0·005	0·038	0·530

The alternate stresses were applied in machines working upon Wöhler's cantilever principle, in which the specimen projects axially from the end of a rotating shaft, and a load is applied by means of a calibrated spring in such a manner as to bend the specimen, whose rotation, therefore, causes the alternation of the plane of bending in the specimen. The design of the machines, and the method of preparation of specimens were such, that any local application of stress due to the method of gripping, any con-

centration of stress due to too rapid change of section, and the possibility of a tool mark upon the specimen acting as a starting point for a crack, were entirely avoided. The strain effects were observed at intervals under the Microscope upon a longitudinal face of the piece which had previously been polished, and, if necessary, lightly etched, a faint outline only of the structure being developed for the purpose of locating, whilst not obscuring, the strain effects. The speed of rotation was in all cases about 400 revolutions per minute. The mechanical results have been elsewhere discussed.

Probably the most interesting series, which at the same time comprises a number of typical features, was one in which the steels were heated for various lengths of time at chosen temperatures, ranging from 600° C. to 1200° C., and allowed to cool slowly with the furnaces. The microscopic strain effects in these specimens can be divided into two types, which, however, gradually merge into one another. In the case of steels tested in the rolled condition, or annealed at temperatures not exceeding about 750° C., the surface becomes greatly ruffled upon fatiguing, and there appear very numerous short crooked outcrops of surfaces, upon which slip has repeatedly occurred. An example is shown in plate IV. fig. 1: it represents a piece of steel A which had been annealed at 620° C. The stress in the field of the photograph was 19 tons per square inch, alternately in tension and compression, and the number of alternations, previous to photographing, 100,000. Plate V. fig. 2 shows another field of the same specimen at a higher magnification, after rupture, which occurred with 252,300 alternations. Specimens which have been heated to, and slowly cooled from higher temperatures, however—and which therefore have become more or less overheated—show a much less ruffled, or practically quite unruffled surface, with relatively few outcrops of surfaces of repeated slip; these outcrops are less crooked and longer than those in the previous class. Plate IV. fig. 3 gives a general view of an incipient crack in a specimen of steel A, which had been heated to, and slowly cooled from 900° C. The stress was 19 tons per square inch, and the specimen had borne 75,000 alternations. Plate V. fig. 4 shows another field upon the same specimen near to the fracture, which formed after 114,300 cycles of stress.

Several years ago Professor Ewing and the author were engaged in studying the nature of Lüders' lines, which, as is well known, appear obliquely to the direction of stress upon a suitably prepared surface of certain metals, when stressed beyond the elastic limit. With further loading a line becomes a band of increasing width, within whose limits the surface of the specimen is visibly ruffled. With moderate magnification the wave-length of these

Fig. 2.

Steel A, annealed at 620° C. After 252,300 reversals of 19 tons per sq. in × 1500.

Fig. 4.

Steel A, annealed at 900° C. After 114,300 reversals of 19 tons per sq. in. × 1500.

undulations in soft irons—Swedish and Low Moor—was found to be from three to five times the average breadth of crystal grains in the specimen. The author has since found a similar relation between the wave-length and size of grains in both normal and overheated samples of steels of the series referred to above, upon loading them statically in tension. Further, it is found that the ruffling of the surface, observed in fatigued samples of the normal class, has also a similar relation to the structure.

The crests follow very irregular lines on the observed surfaces; this and the variability of the wave-length point to the dependence of the form, dimensions, and indeed existence, of the undulations upon the microscopical heterogeneity of the material.

The properties of these undulations, and the observation that the slips in the normal samples when fatigued are numerous—though not so numerous, it should be remarked, as in similar specimens severely overstrained statically—show that there is a tendency for the inelastic and injurious strain to be much more minutely subdivided and uniformly distributed throughout the mass of the normal than of the overheated steels. This helps to explain why overheated steels are less enduring than normal steels under alternating stresses—a fact which is now established beyond doubt by Stead's experiments and the author's.

When fatigue has proceeded to a late stage, it is possible to see a fine crack in ductile metals without the aid of the Microscope; and in the last few reversals before rupture the crack is usually widely open. But the cracks may have developed to such an extent as to weaken the piece dangerously some time before they are visible to the naked eye, as the following results show. The weakness of such a piece would at once be evident in a static or dynamic test. The primary object of the series of experiments was to determine the probable effect of annealing upon the further endurance of partially fatigued metal, and showed that even at a comparatively early period of the fatiguing, the cracks may have made so much headway that annealing is practically useless. Upon further fatiguing to rupture a specimen which is in this condition, the progress which the cracks had made up to the time of the intermediate annealing is clearly mapped in tint upon the final fracture. The shorter the final stage of the endurance, other things equal, the greater the heat-tint markings upon the fracture. The examples given in the table on the following page illustrate this.

Plate IV. fig. 5 shows the fracture of specimen No. 6 at about $17\frac{1}{2}$ diam. The dark segmental areas are heat-tint marks. These results probably show the cause of difference of opinion existing as to the value of periodical annealing of machine and other parts which are submitted to heavy service. Clearly, annealing

may be of advantage only if contact between the slipping surfaces is not destroyed.

Steel A.—Carbon 0·27 p.c.; annealed at 655° C. for ½ hour, cooled slowly. Maximum alternating stress in each case 22·36 tons per square inch.

Specimen Number.	First Fatiguing, Reversals.	Heat Treatment after First Fatiguing.	Second Fatiguing to Rupture, Reversals.	Heat-tint Marks in Fracture.	Total Reversals.
1	40,000	½ hour at 250°, slowly cooled	52,300	none	92,300
2	70,000	ditto	26,500	some	96,500
3	70,000	ditto	18,200	some	88,200
4	70,000	ditto	17,100	some	87,100
5	70,000	½ hour at 325°, slowly cooled	20,500	some	90,500
6	70,000	ditto	4,400	great (see fig. 5)	74,400

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Maturation in Mus musculus.‡—L. Gerlach finds that two directive mitoses always occur. In three-fourths of the cases observed only one polar body was to be seen after maturation. The chromosomes of the monaster of the first directive mitosis are tetrads. The spermatozoon may enter the ovum between the first and the second monaster stage. Most of the tail enters the ovum. Postponed insemination may hinder the formation of the second polar body.

Ovum of Bat.§—O. van der Stricht gives an account of the structure of the egg of *Vespertilio noctula* during growth of the oocyte, maturation, fertilisation, first segmentation spindle, and early segmentation. There is a very clear difference between the first and second maturation spindles. The chromatic segments of the first spindle resemble those of many invertebrates, especially *Thysanozoon*. The figures suggest that the divisions have the same significance as in Invertebrates. The mitochondria of the oocytes are cytomicrosomes capable of various modes of development; they, and the formations resulting from them, appear during the genesis of the plastic vitellus and the deutoplasm.

Syzygy of Spermatozoa in Dasypus villosus.‖—E. Ballowitz finds that in this Edentate the spermatozoa are very frequently firmly united in pairs ("Syzygien"). What it means remains obscure. Similar phenomena (not to be confused with spermatozoa with two tails) have

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Wiesbaden, 1906, 31 pp. (2 pls.). See also Anat. Anzeig., xxix. (1906) p. 494.

§ Anat. Anzeig., xxvii. (1905) Ergänzungsheft, pp. 17–24.

‖ Op. cit., xxix. (1906) pp. 321–4.

been observed in Dytiscidæ by Ballowitz and by Auerbach, and in *Didelphys* by Selenka.

So-called Conjugation of Spermatozoa and Sertoli's Cells.*—K. Tellyesniczky discusses, with particular reference to the rat, the factors that go to the formation of sperm-bundles, and the so-called conjugation of spermatozoa and Sertoli's cells. The plasma of the sperms coalesces with that of the Sertoli-elements, but this is a merely mechanical fusion due to limited space. There is no special conjugation-process. The general conclusion of the author's study is that mechanical factors—the growth, division, crowding, and shunting of the sperm-cells—are quite sufficient to account for the formation of bundles without any theory of taxis or tropisms.

Heteromorphous Spermatozoa in Rana muta.†—E. Ballowitz notes the regular occurrence of numerous markedly heteromorphous spermatozoa in the mature seminal fluid of this grass-frog (= *R. temporaria*). The atypical spermatozoa are marked by the form of the head and by their movements. The outgrowth of the nucleus and apical piece into an elongated structure has been suppressed, while the tail has its normal development. The case is not comparable to the dimorphism in Prosobranchs, and there is no question of the atypical forms being immature.

Theory of Maturation.‡—M. Kuckuck maintains that the cause of maturation-divisions is to be found in the dynamic dissimilarity of the maternal and paternal components in the "hermaphrodite" sex-cells. In the mother-egg-cell the nucleus of maternal origin is more "energetic" than that of paternal origin, and conversely for the mother-sperm-cell. Only after maturation-divisions is the sexual affinity pronounced—by the separation of paternal and maternal chromosomes in the second maturation-division, which is therefore not only a reducing division, but a segregation-division. The mechanism is due to differences in electric potential, and an elaborate theory is worked out. The fully functional spermatozoa are those with wholly paternal nucleus; those with maternal nucleus are comparable to the second polar bodies (with paternal nucleus) —rudimentary sex-elements deficient in energy.

Origin of the Sertoli or Foot-cells of the Testis.§—C. E. Walker and Alice L. Embleton conclude that the foot-cells of the testis, and the cells forming the walls of the tubules or pockets, have immediately common ancestors; and that if these cells are not identical with certain stages in the series of leucocytic generations, they are derived from cells that were identical not more than two or three generations before.

Observations on Life-history of Leucocytes.‖—C. E. Walker points out that there are remarkable points of similarity between the life-histories of leucocytes and those cells in plants which, though reduced, never become converted into sexual elements. This comparison is

* Arch. Mikr. Anat., lxviii. (1906) pp. 540-72 (1 pl.).
† Zool. Anzeig., xxx. (1906) pp. 730–7 (11 figs.).
‡ Tom. cit., pp. 345–57 (12 figs.).
§ Proc. Roy. Soc. London, Series B, lxxviii. No. B 522 (1906) pp. 50-52 (2 pls. and 1 fig.).
‖ Tom. cit., pp. 53-9 (4 pls.).

carried further by what has been observed with regard to the origin and history of the foot-cells of the testis. He is forced to the conclusion that either the leucocytes themselves or their immediate ancestors may give rise to connective tissue, the former probably being what really happens. It is pointed out that one of the earliest phenomena observed in the development of cancer is the fusion of a leucocyte with a tissue-cell, and the subsequent division of the cell resulting from the fusion into two daughter-cells, each possessing chromatic elements derived partly from the leucocyte, and partly from the tissue-cell. Among the cells of malignant growths all the forms of division recorded in this paper for leucocytes and their immediate ancestors are to be found.

Aortic Arches in Vertebrates.* —W. C. Locy has succeeded in injecting a number of chick-embryos of between four and five days, and by this means has clearly demonstrated that the fifth arch is an anterior offshoot of the sixth. It is a veritable aortic arch, agreeing histologically in all essential features with the other arches. Its period of existence is, however, much briefer, and it is also subject to greater individual variation. The author comments on the condition of the fifth and sixth arch in other vertebrate groups; he considers that while vascular elements exhibit greater variability in their stages of formation and degeneration, there are recorded a sufficient number of cases of their aggregation into a complete vessel to justify the assumption that there is a fifth aortic arch in mammals as in other Vertebrates.

Development of Human Thorax.†—Charlotte Müller, by means of reconstruction models, has investigated the characteristics of the thorax in very early embryos. She distinguishes purely embryonal and embryonal atavistic characters. Of the former, the most interesting feature is the contraction in the lateral wall; of the latter is the transitory keel form, which is limited to the proximal region of the thorax. This keel formation is very widely found amongst lower mammals; it is replaced in the primates by the dorso-ventral flattening. This stands in relation to the upright position and the freer development of the upper extremity. In the human embryo the thorax has a greater dorso-ventral than transverse diameter.

Placental Syncytia.‡—H. Strahl has examined the placenta in a number of types, e.g. *Myrmecophaga*, *Dasypus*, *Aluata caraya* Humb., and finds an unusual development of syncytial villi, probably of importance in the nutrition of the fœtus. These forms exhibit an interesting resemblance to the human placenta.

Uterus of Hedgehog after Parturition.§—H. Strahl finds that when the puerperal involution of the uterus of the hedgehog is compared with the same process as it occurs in other mammals, the hedgehog occupies an intermediate position between Rodents and Carnivores. "It stands near the former in the way in which the

* Anat. Anzeig., xxix. (1906) pp. 287–300 (10 figs.).
† Morphol. Jahrb., xxxv. (1906) pp. 591–696 (21 figs.).
‡ Anat. Anzeig., xxix. (1906) Ergänzungsheft, pp. 69–73.
§ Proc. Section Sciences K. Akad. Amsterdam, viii. (1906) pp. 812–14.

epithelium regresses, near some of the latter in the regression of the layer of connective tissue, although in this respect the analogy is not complete."

Development of Peripheral Nerves.*—R. G. Harrison has made a number of experiments on frog larvæ, and comes to the following conclusions. The axis cylinder of the nerve-fibre is the outgrowth of a single ganglion-cell, with which it remains in continuity throughout life. It grows gradually from the centre towards the periphery, establishing secondary connection with its end organ. The other elements, the cells of Schwann, which are found upon the developing nerve, have nothing to do with its genesis, though they may play an important part in the nutrition and protection of the fibres.

Development of Human Cerebellum.†—L. Bolk notes, *inter alia*, that in the grooving of the human cerebellum two stages may be observed; in the first stages those grooves arise that in general are characteristic for the mammalian cerebellum, in the second stage those grooves become visible that are typical for the cerebellum of the Primates. The cerebellum of the Primates, as compared to that of the other Mammals, is characterised by a progressive development of the anterior and middle zones and a regression of the posterior zone. The facts of development suggest that the cortex of the cerebellum is not an organ with an homogeneous distributed function, but a well-organised entirety with localised functions.

Development of Pancreas in Alytes obstetricans.‡—W. Braun has followed this, and finds that the pancreas arises from the undifferentiated cells of the yolk-mass, on the border of the anterior part of the yolk-gut. There are three primordia, a dorsal and two ventral; the dorsal arises first, the others later. The three fuse, first the right ventral with the dorsal, then the left ventral with these. The whole development up to the time of fusion is completed while the larva grows about 1 mm. (4·5 mm. to 5·5 mm.). The pancreas-cells, which are formed from the primitive yolk-cells massed on the yolk-gut, become transformed into epithelial gland-cells only after fusion of the primordia. Active cell-multiplication by nuclear division takes place in all three parts equally, and the organ thus increases in size. The tubular character of the gland is developed gradually from the centre to the periphery, so that in the later stages the marginal portions show an arrangement of compactly-arranged cells. In the adult animal the organ lies in the concavity of the gastro-duodenal loop.

Weight of Hen's Eggs.§—E. Schein comments on the very variable size and weight of the eggs of the common fowl. Some bantam eggs weighed 30–35 grm., while those of Spanish hens weighed 70–75 grm. Seven weighed 1 lb. The average of 165 Thuringian fowls' eggs (weighed by Dr. Lenz-Schnepfental) was 62 grm. The author reports

* Amer. Journ. Anatomy, v. (1906) pp. 121–31 (5 figs.).
† Proc. Section Sciences K. Akad. Amsterdam, viii. (1905) pp. 85–91.
‡ Morphol. Jahrb., xxxvi. (1906) pp. 27-51 (2 pls.).
§ Jahresb. Ges. Nat. Gera, lxvi–lxviii. (1906) pp. 179–80.

two eggs weighing 125 grm. each, and with dimensions 79 by 51 mm. and 79 by 50 mm.! He also reports spherical and retort-shaped eggs.

Ichthyosaurus with Embryos.*—A. Smith Woodward notes that the British Museum has recently acquired two fine specimens of this viviparous extinct reptile. One specimen, discovered and described by J. Chaning Pearce in 1846, is from the Lower Lias of Somersetshire, appears to be *I. communis*, and contains one relatively small embryo. The other specimen, referable to *I. quadriscissus* = *I. acutirostris*, is from the Upper Lias of Würtemberg, and contains at least six embryos. The largest number of embryos hitherto observed in one individual of *I. acutirostris* is seven, and it is interesting to note that in each recorded case of more than one contained embryo, the young are always directed with the snout forwards.

Evolution without Mutation.†—C. B. Davenport refers in particular to the North American song-sparrow (*Melospiza*), whose varieties are connected by intermediate forms, and to species of Scallop. He concludes that the best evidence for slow evolution is found in wide-ranging species, which, while differing greatly at the limits of their range, exhibit all gradations in intermediate localities (*Melospiza*, *Pecten*); also in fossil series (*Pecten eboreus* and *P. irradians*), where the change from one horizon to the next is of the quantitative order. Thus, evolution may take place without mutation. It is no more justifiable to maintain that all evolution is by mutation than that evolution has always proceeded by slow stages.

Black Sheep in the Flock.‡—C. B. Davenport inquires into the origin of black sheep in a flock. They crop out in flocks of breeding ewes and rams that are wholly white. When a quality suddenly arises from parents that have its opposite, the probability is that the two opposed qualities follow Mendel's law in inheritance, and that the new filial character is recessive, the parental opposite dominant. The author states four tests of recessiveness, and tests the recessiveness of the black coat in sheep by Alexander Graham Bell's "Sheep Catalogue" (1904). The conclusion of the whole matter is that black wool colour in sheep behaves like a Mendelian recessive characteristic.

b. Histology.

Collagenous Connective Tissue Fibrils in Matrix of Cartilage, Dentine, and Bone.§—F. K. Studnička has applied the method of Bielschowski (for demonstrating neuro-fibrils) in showing the occurrence of connective tissue fibrils in the hyaline cartilage of the lamprey, in the dentine of dogfish scales, and guinea-pig's incisors, in the bones of *Belone*, and the human fœtus.

Histology of Metamorphosis in Anura.‖—Dr. Duesberg discusses the atrophy of the tail and the metamorphosis of the intestine. As

* Geol. Magazine, iii. (1906) pp. 443–44 (1 pl.).
† Journ. Expér. Zool., ii. (1905) pp. 137–43.
‡ Science, xxii. (1905) pp. 674–5.
§ Anat. Anzeig., xxix. (1906) pp. 334–44 (10 figs.).
‖ Arch. Biol., xxii. (1905) pp. 163–221 (2 pls.).

regards the former, he is absolutely opposed to the view of Metchnikoff regarding the role of phagocytes. There is a complete histolysis of the tissues, with probable elimination in part and modification for nutrition of the remainder by the liver and spleen. Regarding the intestine, there are macroscopic modifications consisting in peristaltic contraction producing a reduction of calibre and length of the small intestine, with microscopic modifications. These last are essentially a desquamation of the striated layer of cells of the larval epithelium, and the formation of the adult epithelium at the expense of the basal cells, which during this regeneration pass through a sort of syncytial stage. The phenomena observable in the stomach consist simply in the throwing off of the superficial layer of epithelium.

Trapezium of Rabbit.*—N. Antoni and A. Björk have found, with the aid of the new neuro-fibrillar method of Cajal, that the neurites ending in the cell nucleus of the trapezium and associated ganglion-cells show in their mutual relations a different appearance according to age. In the trapezium of new-born animals they find peculiar intra-cellular formations, which show as black slightly branched threads, with a tendency to form a network or short rigid rods. They conclude that these structures are probably of a nervous nature.

Regeneration of Nerves.†—F. W. Mott, W. D. Halliburton, and A. Edmunds describe several series of experiments with the nerves of monkeys and cats. They have obtained strong evidence in favour of the Wallerian doctrine, that new nerve-fibres are growths from the central ends of divided nerve-trunks. Regenerated fibres, after being again severed from the central nervous system, always degenerate in a peripheral direction only. The nerve-sheath has a phagocytic and nutritive function; at the central end of a severed nerve this nutritive function is effective in providing actively for the lengthening of the axis cylinders. At the peripheral end, unless the axons reach it, there is no real new formation of nerve-fibres. If, however, the axons reach the peripheral segment, the work of the neurilemmal cells has not been useless, for they provide the supporting and nutritive elements necessary for its continued and successful growth. All the facts made out by the authors are readily explicable on the theory that the nerve-fibres are growths from the central ends of divided nerves.

Structure of Mammalian Lung.‡—Franz Eilhard Schulze returns to a subject which he discussed in 1871, when he described a tree-like branched canal-system of ducts beset with alveoli, and ending in blind saccular infundibula or air-sacs. He discusses the size of the alveoli in various mammals, the number of alveoli, and the size of the entire respiratory surface (about 30 square metres for man, 150 million alveoli; about 43 square metres for the dolphin, 437 million alveoli). He describes the gaps in the partition wall of the alveoli, the capillary network of the alveoli, and so on.

* Anat. Anzeig., xxix. (1906) pp. 300–7 (13 figs.).
† Proc. Roy. Soc., Series B, lxxviii. No. B 525 (1906) pp. 259–83 (1 pl. and 5 figs.).
‡ SB. k. Preuss. Akad. Berlin, 1906, pp. 225–43 (7 figs.).

Cytology of Coccygeal Gland.*—O. Stoerk has investigated the question of the chromaffin reaction of the cells of the coccygeal gland in man, and its relation to the sympathetic nerve. His conclusion is that these cells do not give this reaction either in fœtal or post-fœtal life. There is no histogenetic connection with the sympathetic; such a relation exists rather with the branches of the medial elements of the arteria sacralis media.

Preen-Gland in Birds.†—B. Lunghetti describes the structure and mode of origin of this organ in a number of birds. It appears to arise differently in different cases, and primary and more advanced conditions can be distinguished. The gland always consists of two lobes, though in some fusion—e.g. *Passer*—takes place. Each lobe contains a cavity, larger in the adult than in the young, which arises from the blending of the exit ducts of the constituent glands. There are several types of cell in the glandular epithelium, the exterior series of which is extremely rich in fat.

Intra-vital Staining of Bone.‡—E. Retterer has experimented on this subject, and finds that colouring substances such as Congo-red, methylen-blue, indigo-carmin, etc., behave like nutritive elements, uniting with the living protoplasm and, when their administration is suspended, disappearing by absorption. These intra-vital colorations demonstrate the pre-existence of the amorphous elements in bony tissue, for they are seen to have in the living bone the same form and arrangement as in bone well fixed and coloured. Osseous canaliculi or nutritive canals do not exist in living bone.

Exoskeleton of Syngnathus.§—W. Kasanzeff finds that the main part of the definitive integumentary covering of the pipe-fish is formed from bony tissue, which arises in the connective-tissue between the in-sunk ectodermic primordia and the epidermis.

Synapsis in Newt.‖—J. E. S. Moore and Alice L. Embleton find that the somatic chromosomes are visible in the resting cells; that during the inception of the synaptic phase these chromosomes pair so as to form double bodies, which are the forerunners of the adult gemini (heterotype chromosomes, allotype chromosomes, bivalent chromosomes, etc.); that by growth and elongation the gemini constitute the polarised loops of the first maiotic prophase; that these loops become longitudinally split and, later, each longitudinally divided aggregate rolls itself up into one or other of the forms assumed by the adult gemini; that in these later stages in *Triton* the longitudinal fission of the chromosomes becomes almost but not quite closed up, and in the diaster the separated chromosomes again exhibit it; while, finally, it is seen that this split functions in the second maiotic (homotype) division.

* Arch. Mikr. Anat., lxix. (1906) pp. 322–39 (2 figs.).
† Tom. cit., pp. 264–321 (2 pls. and 11 figs.).
‡ Journ. de l'Anat. et Phys., xlii. No. 5 (1906) pp. 436–86 (1 pl.).
§ Zool. Anzeig., xxx. (1906) pp. 854–61 (6 figs.).
‖ Proc. Roy. Soc. London, Series B, lxxvii. No. B 521 (1906) pp. 555–62 (4 pls. and 8 figs.).

Permanent Forms among Chromosomes of Different Animals.*—J. E. S. Moore and G. Arnold have investigated the forms of "heterolytic gemini" in man, rat, newt, cockroach, etc. There are permanent structural types in the gemini of different organisms. In any particular form the numbers of gemini of each type have a constant numerical relationship to each other. Certain types of gemini appear to be common to all the widely separated forms studied. The number of different types of gemini is less in the phyletically oldest form examined—the cockroach.

Both in regard to the permanent types of gemini and their numerical relationships, as well as with respect to the numerical constancy in the chromosomes themselves and their periodical reductions, we are face to face with constant arrangements in the parts of the unit of living substance (the cell) which seem to underlie and to be quite independent of those external interactions that are supposed to have helped to build the grosser features of living things.

The existence of different types of gemini implies substantive differences between the chromosomes that can unite to form the different kinds.

The present position may be in part summed up as follows. In the fertilised egg the paternal and maternal chromosomes divide independently on the spindle of the first segmentation figure. They go on dividing in a similarly independent manner throughout the soma, and during the pre-maiotic history of the reproductive elements themselves. In the synapsis which ushers in the maiotic phase the chromosomes unite in pairs, and in those cases hitherto examined only certain individual chromosomes are capable of uniting with one another to form differing groups of gemini. In each of these groups the number of gemini is more than one, and it varies in the different species hitherto studied.

Culture of an Artificial Cell.†—Stéphane Leduc has studied the phenomena exhibited by an artificial cell—a "granule" of sulphate of copper, saccharose, and water, placed in an aqueous solution containing ferrocyanide of potassium, salt, gelatin, etc. The granule surrounds itself with a membrane of ferrocyanide of copper, permeable to water and certain ions, but impermeable to the sugar which it encloses, and which produces in the granule the strong osmotic pressure determining absorption and growth. There is "nutrition by intussusception," "organisation"—in the form of "stem," "leaves," and "terminal organs,"—a circulatory apparatus, and growth.

c. General.

Nervous System of Vertebrates.‡—J. B. Johnston has given a connected account of the nervous system of Vertebrates, especially in its phylogenetic and physiological aspects. A general text-book on the subject has been a desideratum for many years, and Professor Johnston's volume is very welcome.

* Proc. Roy. Soc. London, Series B, lxxvii., No. B 521 (1906) pp. 563–70 (2 pls.).
† Comptes Rendus, cxliii. (1906) pp. 842–4 (2 figs.).
‡ The Nervous System of Vertebrates. Philadelphia, 1906, xx. and 370 pp., 180 figs.

Phylogeny of Vertebrate Eye.*—A. Froriep discusses the question of the possible descent of the vertebrate eye from the eyes of ascidian larvæ. His evidence points to the conclusion that the theory of direct descent must be rejected. At the same time, there is much to be said for the view that both organs have arisen from identical forms, to which the eye-pits of vertebrate embryos are nearer than the eye of the Ascidian larva.

Animal Poisons.†—Edwin Stanton Faust gives a comprehensive account of animal poisons, dealing both with those animals which bite or sting, and with those whose flesh or juices are poisonous.

Palæontology and Biology.‡—A. Smith Woodward points out that palæontology bears the same relation to the whole world of life that embryology bears to the structure of the individual organism. "The one deals with the rise and growth of races and their varying relationships, the other describes and interprets the evolution [rather development] of an individual, and the processes by which the different parts of its mechanism are finally adjusted." The biologist equipped with an adequate knowledge of palæontology cannot fail to perceive that throughout the evolution of the organic world there has been a periodical succession of impulses, each introducing not only a higher grade of life, but also fixing some essential characters that had been variable in the grade immediately below. In a very suggestive way the illustrious palæontologist points out that "palæontology contributes to biology by placing the oft-repeated comparison of life with crystallisation in an entirely new light."

Internal Secretion and Nerve Influence.§—M. Nussbaum has investigated this subject experimentally by severing the nerve connections of the thumb of male frogs, and finds that the internal secretion of the sex gland taken up into the blood acts in the same manner as a specific poison does upon definite nerve centres. This action leads through the centrifugal peripheral nerves to an altered condition in the related parts: thus in the secondary sex organs of the frog a striking growth occurs through the medium of the testis secretion, but only when the nerves are sound.

Phylogeny of Buccal Muscles.‖—H. Rouvière gives an account of certain muscles in the floor of the mouth in the five vertebrate classes, and discusses their comparative morphology, with particular reference to the phylogeny of the digastric and genio-hyoid. The digastric in man is formed by the union of two muscles at first distinct; these constitute the anterior and posterior belly respectively of the digastric. The anterior and the genio-hyoid have the same phylogenetic origin, both are derived from the pre-hyoid portion of the sterno-maxillary. The posterior belly of the digastric and the stylo-hyoid are derived from

* Anat. Anzeig., xxix. (1906) Ergänzungsheft, pp. 145–51 (2 figs.).
† Die Tierische Gifte. Braunschweig, 1906, xiv. and 248 pp. See also Ann. Nat. Hist., xviii. (1906) p. 320.
‡ Ann. Nat. Hist., xviii. (1906) pp. 312–18.
§ Anat. Anzeig., xxix. (1906) pp. 431–2.
‖ Journ. de l'Anat. et Phys., xlii. (1906) No. 5, pp. 487–540 (3 pls.).

the transverse jugular. The anterior and posterior digastric elements in Mammals are united at their hyoid extremities. An intermediary tendon is thus formed, which may be transformed into a complete or incomplete tendinous intersection, and which may disappear entirely when the digastric becomes monogastric.

Mathematical Theory of Skin Ridges.* — G. Kolossoff and E. Paukul discuss a theory of the skin-ridge figures of the palma and planta of primates upon the basis of a system of "neutral lines." They seek to show that a marked tendency towards spiral growth of epidermal formations is present not only during development, but during the whole of life, and that this is related to their system of neutral lines. The tactile corpuscles, the spiral winding of sweat canals, the spiral arrangement of the hair roots, especially in curly hair, are quoted as examples. The authors are of opinion that the skin ridges present an important physiological problem for investigation.

Transverse Muscle in Human Orbital Cavity.† — Giovanni Perna records this somewhat rare abnormality in an individual fifty-seven years of age. He regards it as the remnant of the primitive muscular membrane which surrounds the organ of vision in the lower vertebrates, but which has disappeared in phylogeny in relation to the bony development, affording a deeper cavity and a more secure protection for the eye.

Supernumerary Sutures in Human Palate.‡ — F. Frassetto records the occurrence of supernumerary sutures with fontanelles and fontanellary ossicles in certain human skulls in the Anatomical Institute of Bologna. In most cases there are two such sutures, articulating laterally with the palato-palatine behind, and the incisor suture in front. Associated are four small fontanelles, with relative fontanellary ossicles; the anterior pair he named fontanelles amphiporici, and the posterior fontanelles amphistaurici.

Plantar Arch in Man.§ — L. Dubreuil-Chambardel describes a superficial plantar arch in man. It appears to be not altogether rare, having been found in five out of 101 cases at Tours. It is a reversion to the embryonic condition; its disappearance in the normal adult is due to the loss of independence of the different constituent parts of the foot and the limitation of movements. In the lower apes, which effect the most varied movements with the feet, it is well developed. Where it occurs there is a clearly defined differentiation of the arterial system into a superficial and a deep plexus.

Taxonomic Position of Irish Giant Deer.‖ — Einar Lönnberg argues that the likeness between the Fallow Deer and the Giant Deer is only superficial, and that there seems to be more real affinity between the latter and the Reindeer. The affinity, however, is not close enough to justify a union of these two animals in such a way as the Giant Deer and the Fallow Deer have been usually, but wrongly, associated. The

* Morphol. Jahrb., xxxv. (1906) pp. 697–708 (7 figs.).
† Anat. Anzeig., xxvii. (1905) Ergänzungsheft, pp. 215–23 (2 figs.).
‡ Tom. cit., p. 214. § Tom. cit., pp. 175–6.
‖ Arkiv. Zool., iii., No. 14 (1906) pp. 1–8 (2 figs.).

Giant Deer is too much specialised for that, and deserves to hold a somewhat independent place in the system. On the other hand, the Giant Deer and the Reindeer are phylogenetically much more closely related to one another than either of them is to any other member of the Cervicornia.

Tertiary Vertebrates of the Fayûm.*—C. W. Andrews makes, in this descriptive catalogue, an important contribution to the phylogeny of the Proboscidea. His description of *Arsinotherium*—an extraordinary rhinoceros-like mammal—is of great interest, especially as the conclusion is that this bizarre ponderous type is descended from the same ancestral stock as the Hyracoidea. It is argued, *inter alia*, that the Sirenia are related to the Proboscidea, and the Cetacea to the Creodonta. We cannot do more than notice the "Catalogue," but its importance to students of the Mammalia is very great.

Pericardial-Peritoneal Communication in Rabbit.†—F. Hochstetter finds that in rabbit embryos there exists on each side an open connection between the pericardial and peritoneal cavities. These communications arise ventrally from the mesocardia lateralia and laterally from the venæ omphalomesentericæ. He names them the ductus pericardiaco-peritonealis (ventralis).

Hair of Spiny Anteater.‡—K. Toldt, Jun., describes a series of transition forms of hair from a specimen of *Tachyglossus* (*Echidna*) *aculeatus*. These range from delicate wool to the true spines through fine gradations. The intermediate forms have long and strong terminal thickenings. The question as to whether spines or hairs represent the more primitive state cannot be settled by the evidence here supplied, for it may be used to support either view. The case speaks for great individual variability of the coat of the anteaters in general. The hair should not be used for systematic distinctions.

Relationships of Orang-Utan.§—Mario Chio has experimented with the blood-test method, and finds evidence that the blood of the orang has much more affinity with that of man than with that of *Macacus*, or any non-Anthropoid.

Occipital Condyles in Mammals.‖—C. S. Mead discusses the adaptive modifications of the condyles. The degree of mobility possessed by the head is directly correlated with the curvature of the condyles, and to some extent with their sessile or pedunculate position. The sessile condition never occurs except when the neck is short. When the head can be turned through a large arc the condyles are strongly curved and pedunculate. The condyles of such a form as the hedgehog represent a generalised type; the sea-otter (*Latax lutris*) is specialised, having four accessory condyles, or six altogether. The adaptations to carnivorous

* A Descriptive Catalogue of the Tertiary Vertebrata of the Fayûm, Egypt. Printed by order of the Trustees of the British Museum. London, 1906, xxxvii. and 324 pp., 26 pls.

† Anat. Anzeig., xxix. (1906), pp. 41–9 (7 figs.).

‡ Zool. Anzeig., xxx. (1906) pp. 305–19 (5 figs.).

§ Atti R. Accad. Sci. Torino, xli. (1906) pp. 1093–7.

‖ Amer. Naturalist, xl. (1906) pp. 475–83 (2 figs.).

habits are illustrated. Thus "as the animal became more carnivorous in its diet, capturing larger animals, the condyles became larger and stronger, extended forward, became approximated, and finally fused, forming a type with a large condylar area." All the orders of mammals are passed under review, and their condyles interpreted.

Hybrid Hares.*—Einar Lönnberg gives scientific evidence of hybrids between the native variable hare of Scandinavia (*Lepus timidus* L.) and the common hare of Middle Europe (*L. europæus* Pall.). One specimen showed characteristics of both species, but was physically stronger in certain respects than either of them. Another, with more of the characters of *L. europæus* than the former specimen, is perhaps a product of a secondary crossing between a hybrid of the first degree and *L. europæus*. In two others the characters derived from the variable hare are more dominating, which is again suggestive of a secondary crossing.

Action of Pituitary Extract upon the Kidney.†—E. A. Schäfer and P. T. Herring have shown that intravenous injections of saline extract of the infundibular part of the pituitary body produce dilatation of kidney vessels accompanied by increased flow of urine. It is concluded that the infundibular part of this gland produces an internal secretion which passes into the blood, and which, both indirectly owing to its general action upon the vascular system and directly by its special action on the renal vessels and renal epithelium, assists in promoting and regulating the secretion of urine. In short, the internal secretion is ancillary to the renal functions.

Sympathetic Nervous System in Monotremes.‡—A. J. P. v. d. Broek describes this in *Echidna aculeata* and *Ornithorhynchus paradoxus*. The sympathetic system of the two types is similar in many respects—in structure and ramification; in other respects they show important differences from placental mammals. It appears that *Ornithorhynchus* approaches a little nearer to the conditions in placental mammals in so far as there is a small ganglion cervicale supremum which is missing in *Echidna*, and the sympathetic cord does not enter directly into the suprarenal body as is the case in *Echidna*.

Squamosal Bone in Tetrapodous Vertebrata.§—F. W. Thyng has followed this bone throughout the higher Vertebrata. The mammalian squamosal is a membrane bone overlying the otic capsule, and at first intimately connected with the incus (quadrate) by a dense and fibrous stroma. Juxtaposition with the parietal has been secondarily acquired. The supratemporal of Stegocephala has been lost, and its place has been bridged secondarily by the upward development of the squamosal. In the temporal region of the Stegocephalian skull there are two bones external to the parietal. The more lateral (from its relation to the quadrate, otic capsule, and jugal) is the squamosal. The more median is the supratemporal. The term "paraquadrate," introduced by Gaupp,

* Proc. Zool. Soc. London, 1905, pp. 278–87 (2 figs.).
† Proc. Roy. Soc. London, Series B, lxxvii., No. B 521 (1906) pp. 571–2.
‡ Proc. Section of Sciences k. Akad. Amsterdam, viii. (1906) pp. 91–5 (1 pl.).
§ Proc. Boston Soc. Nat. Hist., xxxii. (1906) pp. 387–425 (4 pls.).

is unnecessary, since that bone of the Urodelan skull agrees perfectly with the Mammalian squamosal.

Albinism in Coot.*—J. Pellegrin describes the rare case of an almost perfectly white coot (*Fulica atra*) from the marshes of Clèry in the department of Somme. The whole plumage was snowy white except a few ashy feathers at the end of each wing. The eyes were normal.

Ross's Gull in the Mediterranean.†—Giacinto Martorelli gives an account of the somewhat astonishing appearance of Ross's gull (*Rhodostethia rosea*) in Mediterranean waters in the vicinity of Sardinia.

Chelonians of Brazil.‡—Emilio A. Gœldi gives a general introductory account of the Chelonians of Brazil, dealing with 13 genera and 25 species.

Enteron and Integument of Cryptobranchus.§—A. M. Reese gives brief notes upon the alimentary canal and integument of *Cryptobranchus allegheniensis*. There are no particularly striking features in the lining of the oral cavity. The tongue has only a short portion free from the hyoid, and its musculature is not strongly developed. No trace of the sense organs described by Kingsbury in the tongue of *Necturus* was observed. The lining epithelium of the mucosa of the œsophagus is of the ciliated stratified variety, but goblet, and irregular basal cells are present also. Notes, similar in character, on the stomach, intestine, and rectum are also given. The most interesting features of the integument which are described are the neuromasts or organs of the lateral line system. They do not show much elevation of the surface. The epidermis dips down and becomes reduced to a single layer of cells. A comparatively wide opening connects the cavity formed with the exterior. At the bottom of the cavity there are small conical cells with deeply staining nuclei (sensory cells). The nerve connections of the organ were not clearly made out.

Variations in Length of Frog's Intestine.‖—Emile Yung finds that the intestine of *Rana fusca* is always shorter than that of *Rana esculenta*; that it is always shorter in males than in females; that it is relatively shorter in large frogs that have finished their growth; and that it is relatively shorter in early spring than in late autumn.

Electric Organ of Stargazer (Astroscopus).¶—Ulric Dahlgren and C. F. Silvester describe a new form of electric apparatus in this American Teleost. It is an organ of high specialisation and efficiency, and quite unlike others in its structure. It consists of two irregular vertical columns behind and somewhat under each eye, extending from a peculiar bare spot on the top of the head down to the roof of the mouth. Each column is composed of a large number of flat, thin

* Bull. Soc. Zool. France, xxi. (1906) pp. 62–4 (1 fig.).
† Rend. R. Ist. Lombardo, xxxix. (1906) pp. 181–92.
‡ Bol. Mus. Gœldi, iv., No. 4 (1905–6) pp. 699–756.
§ Trans. Amer. Micr. Soc., xxvi. (1905) pp. 109–20 (2 pls.).
‖ Arch. Sci. Phys. Nat., xxi. (1906) pp. 535–6.
¶ Anat. Anzeig., xxix. (1906) pp. 387–403 (13 figs.).

electric plates or electroplaxes lying horizontally, separated by jelly-like electric connective tissue. Inside the delicate bounding electrolemma of the electroplax the cytoplasm is arranged in three horizontal layers—(*a*) the layer of electric nuclei, with peculiar rod-like or thread-like objects running horizontally; (*b*) a non-nucleated layer, with web-like cytoplasm; and (*c*) a dense cytoplasmic layer, with uniformly distributed nuclei, and with more distinctive striation than in any other electric fish.

Sense of Hearing in Fishes.*—Marage has experimented with carp, tench, pike, eel, and other fishes, and finds no evidence of a sense of hearing. The vibrations of synthetic vowels were transmitted into the water immediately adjacent to the fishes, with an energy capable of affecting deaf-mutes, but no results were visible.

Sharks' Teeth and Cetacean Bones.†—C. R. Eastman discusses the distribution of sharks' teeth and Cetacean bones on the ocean floor. Teeth of Lamnidæ and Carchariidæ occur in all parts of the Pacific, but are much more plentiful in southern tropical regions than elsewhere. Cetacean ear-bones are found only exceptionally north of the equator, but are abundant south of it, especially between parallels 10° and 40° south. Amongst Cetacean remains, those belonging to dolphins and Ziphioids are the most common, and most widely distributed; those belonging to whalebone whales (rorquals) are unknown north of parallel 32° of south latitude; and no indication of large sperm whales has been found in any part of the Pacific, not even in those regions now frequented by Physeteridæ.

On the last 'Albatross' Expedition (1904–1905) the largest haul of sharks' teeth and Cetacean bones were made at stations lying within the so-called barren regions, that is to say, areas far removed from the land, beyond the reach of telluric food-supply, and characterised by a most meagre pelagic fauna. The extent of these regions is sometimes such as to constitute veritable death traps, comparable to deserts on the land, for marine vertebrates that happen to have strayed therein. Thus it is a significant fact that 70 p.c. of the entire amount of material obtained during the last cruise of the 'Albatross' was dredged within the barren area.

New Species of Pteridum.—L. W. Byrne‡ describes *Pteridum alleni* sp. n., captured at the mouth of the English Channel, near La Chapelle Bank, at about 450 fathoms, on a recent cruise of the S.S. 'Huxley,' employed by the Marine Biological Association in their co-operation with the International Fishery Investigations. We note this new species because hitherto only one species of *Pteridum* Scopoli, as defined by Günther,§ has been described, namely, *Pteridum atrum* Risso, a denizen of the Mediterranean coast of France, where, however, it appears to be uncommon. The distinctive peculiarities of this new species are compared with those of *P. atrum*.

* Comptes Rendus, cxliii. (1906) pp. 852–3.
† Bull. Mus. Comp. Zool. Harvard, l. (1906) pp. 75–98 (4 pls.).
‡ Ann. Nat. Hist., xviii. (1906) pp. 448–50 (1 fig.).
§ 'Challenger' Deep-sea Fishes, p. 105.

Palæoniscid Fishes.—R. H. Traquair * reports on the fragmentary remains of a Palæoniscid fish from the base of the Pendleside Series, near Holywell, Flint. The configuration of the mandible and maxilla clearly prove that the specimen belongs to the Palæoniscidæ. According to the form and sculpture of the scales, and the configuration of the jaws, the fish might appertain either to *Rhadinichthys* or to *Elonichthys*. Perhaps the scales have the greatest resemblance in sculpture to those of *Elonichthys egertoni* Egert., but the denticulations of the posterior margin are proportionally coarser. The association of fine striæ with comparatively coarse denticulations of the under margin is a feature which leads Dr. Traquair to regard the species as new to science, and he proposes to name it *Elonichthys denticulatus*.

A. Smith Woodward † describes a specimen of *Myriolepis hibernica* Traquair from the Irish Coal-Measures, and gives a more complete diagnosis, noting in particular the stoutness and shortness of the abdominal region, and the forward position of the dorsal fin.

Horny Teeth of Marsipobranchs.‡—H. W. Marett Tims points out the resemblances in structure and development between Teleostean scales and the horny teeth of the lamprey. If this suggestion is correct, the horny teeth must be regarded as purely dermal structures. The true epidermal layer may have been absent in the specimens studied by Beard, who regarded the teeth as epidermal. The horny plates may be compared to the calcified portion of the Teleostean scale, possibly also to the dentinal layer of true teeth.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Cranchiidæ.§—Carl Chun gives a diagnosis and classification of this family of cuttlefishes, and establishes a number of new genera—*Corynomma*, *Crystalloteuthis*, *Sandalops*, *Toxeuma*, and *Bathothauma*.

γ. Gastropoda.

Cytology of Salivary Glands in Helix pomatia.‖—M. Pacaut and P. Vigier give some notes on the chromophile formations (ergastoplasm, chondriomites). In the salivary glands there are five types of cell—punctate, alveolar, granular, cystic, and mucous. The first two especially possess chromophile formations remarkable for their size, number, and diversity of aspect. Amongst these are distinguishable (1) the calotte or growing chromophile in contact with the nucleus; (2) the parasome with concentric capsules, mostly spherical and occurring anywhere in the cytoplasm; there may be from 1 to 15 or more in a cell, there are often several within a filamentous capsule; (3) the "bandelette chromophile,"

* Geol. Mag., Decade V., iii. (1906) pp. 556–7 (2 figs.).
† Ann. Nat. Hist., xviii. (1906) pp. 416–19 (1 pl.).
‡ Proc. Cambridge Phil Soc., xiii. (1906) pp. 383–6.
§ Zool. Anzeig., xxxi. (1906) pp. 82–6.
‖ Anat. Anzeig., xxvii. (1905) Ergänzungsheft, pp. 151–3.

variable in number and form, in the periphery of the cell, and parallel to its surface. These chromophile formations are like the vitellogenic parts of certain ovocytes at the growing period. The authors give also an account of the maturation and solution of the zymogen granules of the glands.

δ. Lamellibranchiata.

Movements of the Shell-valves.* — F. Marceau has analysed the "rocking movements" ("mouvement de bascule") exhibited by some bivalves during the opening and shutting of the shell. It cannot be seen in Monomyaria, such as *Pecten*, nor (*pace* Anthony) in forms like the common mussel. It is well seen in *Lutraria elliptica*, *Psammobia vespertina*, *Mactra glauca*, *Tapes decussatus*, and *Venus verrucosa*. It is much less distinct in the freshwater mussels. The movements in question are associated with the fact that the posterior adductor muscle is a little longer than the anterior, and has its axis a little nearer the hinge.

Water-Currents in Bivalves.†—Hans Wallengren has studied these in freshwater mussels, and also in *Mytilus*, *Mya*, and *Ostrea*. In the resting *Anodonta*, the water passes out only by the anal siphon, but enters by every aperture leading to the infrabranchial chamber. The two currents (ingoing and outgoing) are quite independent. In the mantle cavity the water passes from the infrabranchial chamber through the interfilamentar openings to the suprabranchial chamber. The pallial ciliation of the infrabranchial chamber has no importance in producing the currents, nor have muscular contractions of gills or mantle folds. The currents are primarily due to the lateral cilia on the branchial filaments and to the cilia on the inner portions of the interfilamentar canals and on the inner surface of the lamellæ. In some cases the pallial cilia in the suprabranchial chamber may help, and perhaps also the marginal membranellæ, but these are really filters, and the cirri on the posterior margin of the filaments of *Mytilus* are also of some similar importance. The currents in an unstimulated mussel have a constant strength, but stimulation provokes irregularities, e.g. by closing one opening or both openings. When the shell is quite shut there is still circulation of water. The water in the suprabranchial chamber passes through the split-like opening on the upper free margins of the ascending lamellæ back into the infrabranchial chamber. This communication between the two chambers is also of importance when the adductor movements occur, for a surplus in the upper chamber may be forced into the lower chamber.

Ingestion in Bivalves.‡—Hans Wallengren finds that in *Anodonta*, *Mytilus*, *Mya*, and other bivalves, the taking in of food is an active process. The mouth is not always open. The food-particles are not swept into the mouth by water currents, they are conducted to the buccal groove and deposited there. Then the animal, if it will, may open its mouth and invaginate the proximal part of the buccal groove with its

* Comptes Rendus, cxliii. (1906) pp. 303–5.
† Acta. Univ. Lunds, n.f. Afd. 2, Bd. i. No. 2 (1905) pp. 1–64 (3 pls., 8 figs.).
‡ Op. cit., No. 3 (1905) pp. 1–59 (1 pl., 24 figs.).

accumulated slime-covered particles into the œsophagus. If the foreign particles are not thus ingested, they are sooner or later caught in the marginal stream of the lips and passed along the inferior marginal fringe of the labial palps to their tip, and finally discharged into the efferent backward stream. If the labial palps in consequence of stimulus are drawn together, they usually hinder the food-particles from entering the mouth, and conduct them into the efferent stream. The labial palps in certain states of contraction form the connection between the afferent and efferent streams, and serve to pass material from the one to the other.

Mechanism of Swimming in Pecten.*—Fred Vles has studied the scallop's swimming movements. The opening of the valves is normally in the direction of progression, the hinge is behind. The movement is due to the reaction to the current of water which passes out by the cardinal grooves, the pallial folds acting as a valve and preventing any other issue of the water when the valves are rapidly closed.

Genus Joufia Boehm.†—E. Snethlage, from a study of fresh material of *Joufia reticulata* Boehm, is able to throw some light upon its relationships. Externally, and in the structure of its lower valve, it resembles many Rudistæ (Sphærulites); in the outer layers of this valve it exhibits resemblances to Hippurites. It shows least resemblance to the Caprinidæ, and should be linked to the groups Radiolites and Hippurites.

Arthropoda.

α. Insecta.

Cytological Aspect of Parthenogenesis in Insects.‡—C. Gordon Hewitt gives a useful summary of what is known as to the changes which take place in the maturation and development of unfertilised ova in insects. He uses a slight modification of Henneguy's classification:—(1) Tychoparthenogenesis (accidental and exceptional). (2) Homoparthenogenesis (normal parthenogenesis), including (*a*) thelyotoky (only females produced), (*b*) arrhenotoky (only males produced), and (*c*) deuterotoky (both sexes produced). (3) Heteroparthenogenesis (with alternation of generations). He gives a brief account of the cases in which the cytological changes have been studied.

Except in *Aphis* and a few exceptional cases, three polar nuclei are formed, but they are not extruded, as polar bodies. This may secure cytoplasmic fertilisation, so to speak. "The evidence available on the cytology of parthenogenesis in insects is too small and too diversified at present to allow us to draw any conclusions on questions of heredity and sex, about which we know little."

Structure of Insects.§—Antonio Berlese discusses (in part) the structure of the muscular tissue, tegumentary organs, and glandular

* Comptes Rendus, cxliii. (1906) pp. 611-13 (2 figs.).
† Ber. Nat. Ges, Freiburg, i. Br. xvi. (1906) pp. 1-9 (2 figs. and 2 pls.).
‡ Mem. and Proc. Manchester Lit. and Phil. Soc., l. (1906) No. 6, pp. 1-40 (2 pls.).
§ Gli Insetti. Milan: Societa Editrice Libraria, i. fasc. 16-17 (1906) pp. 457-520.

system of insects. The present part forms fascicles 16 and 17 of a monograph on the economic importance, development, habits, and structure of insects. It is profusely illustrated, and contains exhaustive bibliographies.

Thoracic Segments in Hexapoda and Chilopoda.*—L. B. Walton has investigated the subject of the dorso-lateral longitudinal muscles in the Geophilidæ, and finds that their arrangement corresponds to the division of the segment into an anterior and posterior somite. This, together with the presence of homologous areas in *Scolopendrella*, *Campodea*, *Forficula*, etc., presents a strong case for regarding the segment in the Hexapoda and Chilopoda as composed of two somites. There is evidence for considering that not only is the thorax in Hexapoda composed of six somites, but that each typical segment in the Hexapoda and Chilopoda (Crustacea and Arachnida ?) is composed of two coalesced somites.

Wax-Glands of Honey-Bee.†—L. Arnhart finds that in bees which are actively secreting wax, the cells of the wax-gland are surrounded by intercellular spaces full of air and communicating with adjacent tracheæ. Dreyling noticed these intermediate spaces, but thought that they contained secretion. They contain air only, and their occurrence shows that the production of wax is associated with a strong oxidation.

Coiling of the Aorta in the Bee.‡—L. Arnhart calls attention to the observation of Pissarev, that the aorta, after leaving the heart, but before passing out of the abdomen, exhibits eighteen coils. He interprets this as an arrangement hindering the back-flow of the blood, taking the place of aortic valves. The mechanism of the valves in the heart itself is also discussed.

Spermatogenesis of Hive-Bee.§ — L. Doncaster finds that the nucleus of the primary spermatocyte resolves itself into eight dyads, instead of the usual tetrads; there is only one complete maturation division, which separates the halves of the dyads, so that eight single chromosomes pass to each pole. He confirms the suggestion of Giglio-Tos, that in the spermatogenesis there is no reduction in the ordinary sense, and that the failure of the first maturation division is due to the fact that the primitive germ-cells of the drone contain the reduced number of chromosomes, as might be supposed, if the drone is produced from an unfertilised egg.

Proventriculus and Gizzard of Wood-cutting Bee.‖—L. Bordas gives a detailed account of the minute structure of these parts. The gizzard not only triturates the food, but acts as a regulating filter, and prevents (by means of a valve) the material from passing upwards during the peristaltic movements of the mid-gut.

* Science, n.s., xvii. (1903) pp. 485-6.
† Zool. Anzeig., xxx. (1906) pp. 719-21 (1 fig.).
‡ Tom. cit., pp. 721-2.
§ Anat. Anzeig., xxix. (1906) pp. 490-1 (5 figs.).
‖ Trav. Scient. Univ. Rennes, iv. (1905) pp. 303-19 (9 figs.).

Apidæ of Spain.*—José Maria Dusmet y Alonso is giving an account of the Bees of Spain, and deals in this section with the genus *Cœlioxys*, of which he describes sixteen species.

Social Wasps of Para.†—A. Ducke continues his study of the social wasps of Pará, and deals with seventeen genera. He gives an interesting ethological classification, and fine illustrations of the nests.

Olfactory Sense in Ants.‡—H. Piéron corroborates what other observers have shown, that ants recognise one another by smell. The only sensory basis in recognition is an olfactory one, but the reaction cannot be interpreted as a purely olfactory reflex. There are implicated ethological factors, adaptive responses wrought out by selection, which cannot be ignored.

Stalked Egg of Cynipidæ.§— E. Bugnion gives a detailed description of the stalked egg of *Cynips tozæ* Bosc (*C. argentea* Hartig), which has a pedicel (1·163 mm.) six times longer than the ovum proper (0·197 mm.). This is an adaptation to the mechanism of oviposition. There does not seem to be any alternation of generations in this species, and it may be that the development is parthenogenetic. The male is extremely rare, and at the time when fertilisation could occur (in spring, when the female comes out of the gall), the ova are already completely surrounded by their envelope. It may be, however, that there is a very minute micropyle.

Hermaphroditism in Lepidoptera.‖—K. Wenke describes a hermaphrodite specimen of *Argynnis paphia*, which externally exhibited in a very marked degree female characters upon the left half of the body, and male upon the right. Internally, there was a complete suppression of the male organs, while the female parts were not quite normal, being partly degenerate and partly absent. To the description is added a comparative anatomical account of hermaphroditism in Lepidoptera in general.

Glossina palpalis in Relation to Trypanosomes.¶—E. A. Minchin, A. C. H. Gray, and F. G. M. Tulloch, communicate the results of a series of experiments. Their most important results appear to be :—(1) Infected *G. palpalis* feeding on two healthy animals in succession communicate the "*Jinja*" cattle trypanosome to the first of these only, showing apparently that the infection is conveyed by contamination of the proboscis. (2) Freshly-caught *G. palpalis* are capable of infecting animals with the trypanosome of sleeping sickness, but the number of fly-bites required is very variable—frequently more than a thousand flies have fed on a susceptible animal without infecting it. (3) The development of sexual forms of *T. gambiense* in the alimentary canal of the tsetse-fly has been witnessed ; they are very similar to the forms of

* Boll. Soc. Españ. Hist. Nat., vi. (1906) pp. 134–51.
† Bol. Mus. Goeldi, iv., No. 4 (1905–6) pp. 652–98 (4 pls. and 1 fig.).
‡ Comptes Rendus, cxliii. (1906) pp. 845–8.
§ Arch. Sci. Phys. Nat., xxi. (1906) pp. 536–9.
‖ Zeitschr. Wiss. Zool., lxxxiv. (1906) pp. 95–138 (2 pls. and 15 figs.).
¶ Proc. Roy. Soc. London, Series B, lxxviii. No. B 525 (1906) pp. 242–58 (3 pls.

T. brucei described by Koch. (4) After 96 hours the trypanosomes disappear from the digestive tract of the fly. (5) Two new species, *T. grayi* and *T. tullochii*, have been discovered to occur in freshly-caught tsetse-flies ; these forms are not development stages of *T. gambiense*, and have nothing to do with sleeping sickness. A. C. H. Gray, in an appendix, gives some notes on a *Herpetomonas* from the alimentary canal of *Stomoxys* in Uganda.

The "Unpaired Organ" of Conopidæ.*—R. N. Streiff endeavours to throw some light on the nature of this organ, which is peculiar to the females of this family of Diptera. It is a peculiarly-developed fifth sternite, which appears to have some function in copulation in which the females take an active part.

Flies in Amber.†—F. Meunier discusses the Diptera of the family Dolichopodidæ which occur in Baltic amber. He has found representatives of seventeen genera, all of which are represented in the present-day fauna. All the species are extinct, but are nearly related to living forms.

Internal Structure of Stomoxys.‡—The late F. G. M. Tulloch described the internal structure of the Uganda variety of *Stomoxys*, with the main object of furnishing some comparison with *Glossina*. An account is given of the alimentary, nervous, circulatory, and reproductive systems.

African Termites and Termitophilous Insects.§—F. Silvestri reports on a collection from the colony Eritrea, including *Eutermes heteraspes* sp. n., and three other Termitidæ, and among the termitophilous guests: *Termitodiscus bellicosi* sp. n. (a Staphylinid beetle), and *Thaumatozena andreinii* sp. n. (a Dipterous insect).

Catalogue of Cicadidæ.‖—W. L. Distant has made a critical catalogue of the chaos of over 1000 species of Cicadidæ, which he divides into three sub-families :—

A. Tympanal lid present.
- *a.* Tympanal lid completely covering the tympanal aperture . . . . . . Cicadinæ.
- *aa.* Tympanal lid leaving the aperture more or less open . . . . . . Gæaninæ.

B. Tympanal lid absent . . . . . . Tibicininæ.

Egg-opening Apparatus in a Pentatomid.¶—R. Heymous describes in the embryonic stage of the Pentatomid *Palomena dissimilis* a T-shaped chitinous ridge with a minute apical tooth, situated on the top of the head, and adapted to force open the lid of the egg. When the

* Zeitschr. Wiss. Zool., lxxxiv. (1906) pp. 139–203 (2 pls. and 15 figs.).
† Comptes Rendus, cxliii. (1906) pp. 617–18.
‡ Proc. Roy. Soc. London, Series B, lxxvii. No. B 521 (1906) pp. 523–31 (5 figs.).
§ Redia, iii. (1906) pp. 341–59 (22 figs.).
‖ A Synonymic Catalogue of Homoptera. Part I. Cicadidæ. London: British Museum, 1906, pp. 207.
¶ Zeitschr. f. Wiss. Insekten-Biol., ii. (1906) pp. 73–82. See also Zool. Zentralbl., xiii. (1906) p. 648.

young animal creeps out, it moults, and loses this apparatus, which is another instance of a structure functioning only once in a life-time.

Pollinating Capsid.*—O. M. Reuter describes *Pameridea roridulæ* g. et sp. n., a new Capsid for Cape Colony, which secures the pollination of *Roridula gorgonias*. There are few Capsids that are of importance in connection with pollination, but this new form is well adapted for this role. The whole body is hairy, and this is true also of the antennæ, the first two joints of the proboscis, and the very long legs. From a taxonomic point of view the new Capsid is also interesting; it is a type of a new division (Pamerideria) of Capsidæ.

Colour-Varieties of Nebalenia speciosa.†—F. Ris discusses some of the colour-varieties of this smallest of European dragon-flies, and his results, interesting in themselves, have particular importance, because they do not bear out the conclusions which Darwin and MacLachlan based on the facts known to them in this connection.

Spermatogenesis of Forficula auricularia.‡—H. Zweiger has followed this out in considerable detail. The number of chromosomes is 26; of these 6 are small, 2 medium, and 18 large. The last are almost alike in size, and in the first and second maturation spindles there are 3, 1, and 9 respectively of these types. After several divisions the spermatogonia pass into a growth stage, when the chromosomes are equally distributed over the nucleus. Subsequently ensues a microsome stage, when they are spread over the linin net, almost all taking part. In cells with an accessory chromosome, three of the chromosomes retain at this time their compact form, whilst in those without an accessory chromosome only one retains its form. The maturation divisions are described in detail.

New Genus of Rhipiphoridæ.§—Filippo Silvestri gives an account of *Rhyzostylops inquirendus* g. et sp. n., and discusses its systematic position. The female, egg, and first larva were found on tufa ground in Umbria, and the form is placed provisionally, until the male is known, in the Rhipiphoridæ. The antennæ and labial palps of the female are rudimentary—the mouth, in fact, is reduced to a simple aperture with two short lateral appendages. The tarsi are single jointed. It appears to be intermediate between *Rhipidius* and the Stylopidæ.

Aquatic Cockroach.‖—Nelson Annandale discusses a species of *Epilampra*, living in an Indian jungle stream. The tip of the body is held out of water, and the last spiracle is of a slightly tubular nature, and projects at the side from below the posterior extremity of the seventh tergite, being provided with a thick ring of chitin. The author also notes that an aquatic glow-worm (Lampyrid) larva possesses a star-

* Zool. Anzeig., xxx. (1906) pp. 723–6.
† MT. Schweiz. Entomolog. Ges., xi. (1906) pp. 159–65.
‡ Zool. Anzeig., xxx. (1906) pp. 220–6 (22 figs.).
§ Redia, iii. (1905) pp. 315–24 (1 pl.).
‖ Journ. Asiatic Soc. Bengal, ii. (1906) pp. 105–7.

shaped funnel and tracheæ which can be extended from the posterior end of the body.

Spermatogenesis in Locusta viridissima.*—H. Otte describes the differentiation of the mature spermatozoon—an intricate affair. The anchor-shaped apical piece is due to the idiozome; the bilaterally-symmetrical head includes in its interior an "internal body" due to co-operation of the products of the proximal double-central-corpuscle; in half of the spermatozoa, the head also includes an accessory chromosome. Below the head is a short region due to the proximal double-central-corpuscle—the centrosomal connecting piece. Then follows a long median piece, which consists of the intra-cellular axial filament plus the mitochondrial envelope. The head, connecting piece, and median piece are enveloped in a delicate cytoplasmic envelope. At the end of the median piece there is the distal central corpuscle (invisible in the mature spermatozoon), and then there is a delicate terminal thread due to the extra-cellular axial filament. There seems no end to these minutiæ.

Tympanal Sensory Apparatus of Orthoptera.†—Josef Schwabe describes in full detail the structure of the tympanal apparatus, the associated musculature and nerves, and the nervous end-organs. His elaborate memoir does at last something like justice to these intricate mechanisms.

Injurious Insects in Ireland.‡—George H. Carpenter reports on various injurious insects and other animals observed in Ireland during the year 1905; e.g., the cabbage aphis (*Aphis brassicæ*), the diamond-back moth (*Plutella cruciferarum*), the winter moth (*Cheimatobia brumata*), the December moth (*Pœcilocampa populi*), the pith moth (*Blastodacna vinolentella*), the rice weevil (*Calandra oryzæ*), and the mottled willow moth (*Caradrina quadripunctata*)—the last infesting a dwelling house! The stem eelworm (*Tylenchus devastatrix*), the strawberry eelworm (*Aphelenchus fragariæ*), the field slug (*Agriolimax agrestis*), and other injurious animals outside the class of insects are also discussed.

Large Larch Saw-Fly.§—R. Stewart MacDougall gives an account of *Nematus erichsoni*, which in recent years has been causing serious injury to larch trees in Cumberland. To aid in identification, a description of the adult, caterpillar, cocoon, egg, and excrement is given, as well as a statement of the habits and life-history of this insect.

Studies on Thysanura.‖—K. Escherich continues his studies on Thysanura, and reports a number of interesting new forms, which are chiefly termitophilous Lepismatidæ. He describes as new genera, *Hematelura*, a transition type between *Nicoletia* and *Atelura*; also *Platystylea* and *Assmuthia*, both with very striking sexual dimorphism.

* Zool. Anzeig., xxx. (1906) pp. 750–4.
† Zoologica, xx. heft 50 (1906) pp. 1–154 (5 pls. and 17 figs.).
‡ Econ. Proc. R. Dublin Soc., i. (1906) part 8, pp. 321–44 (5 pls. and 8 figs.).
§ Journ. Board of Agriculture, xiii. (1906) pp. 385–94.
‖ Zool. Anzeig., xxx. (1906) pp. 737–49 (32 figs.).

γ. Arachnida.

Anatomy of Boophilus annulatus Say.*—W. E. Allen describes the integument and musculature, appendages, alimentary tract, salivary glands, malpighian tubules, sex organs, etc., as well as several structures of unknown nature. In the alimentary canal there are six distinct regions. There is no special channel for the passage outward of the salivary fluid during the act of blood sucking, though it may escape around the upper and outer surfaces of the mandibles. It is also possible that the currents may alternate, saliva flowing in intervals of rest from suction. The salivary glands are of the compound alveolar type, rather over 2 mm. in length. In engorged ticks there appear to be on the anterior wall of the body epithelial folds of a glandular nature, but their use or method of discharging their secretion has not been made out.

Genera of Water-Mites.†—R. H. Wolcott gives a very useful account of the genera of Hydrachnidæ. The paper embodies all information on the subject published since the issue of Piersig's monograph. An attempt is made at grouping the genera in divisions of higher rank, a type-species is fixed for each genus, and a diagnostic key—artificial, but complete—is given for all the known freshwater genera.

Phytoptids and Witch's Broom of Birch-Trees.‡—H. T. Güssow has studied numerous cases of "witch's broom" on English birch-trees, and he never found one which was due to *Exoascus turgidus*, or other mycelial infection. They are due to *Phytoptus* (*Eriophyes*) *rudis*, which also causes the bud-galls. He does not seem to believe much in the distinctions between *Phytoptus rudis* and related "species." Professor Nalepa found *Ph. rudis* in the terminal buds, *Ph. betulæ* in the bud-clusters, and *Ph. rudis* in the witch's broom. The author describes the structure of the mite and some stages in the development.

New Species of Fossil Limulus from Jurassic of Sweden.§—R. T. Jackson describes from the Liassic Sandstone at Hör, in Scania, a fragment—a sandstone cast of a portion of the right dorsal side of a large cephalothorax—of what he regards as a new species of *Limulus* (*L. nathorsti*). He compares it with the other three or four fossil species, and notes that this is the first occurrence outside of Germany.

ε. Crustacea.

Annulus Ventralis of Cambarus.‖—E. A. Andrews describes the peculiar annulus ventralis of the females of the crayfish genus *Cambarus*. Of the nine genera of crayfishes *Cambarus* alone has this peculiarity, which varies from species to species. It is an elevation of connective tissue covered by epidermis, forming an exoskeletal pocket, with an open orifice at one end and a suture along its side. The male fills this pocket with sperms and seals the orifice with secretion from the vas

* Trans. Amer. Micr. Soc., xxvi. (1905) pp. 245–80 (4 pls.).
† Tom. cit., pp. 161–243 (10 pls.).
‡ Zeitschr. f. Land. und Forstw., x. (1906) pp. 1–9 (2 pls.).
§ Arkiv. f. Zool., iii. (1906) No. 11, pp. 1–7 (2 figs.).
‖ Proc. Boston Soc. Nat. Hist., xxxii. (1906) pp. 427–79 (6 pls.).

deferens. Within this pocket the sperms remain protected from the water, sometimes for months, until by muscular contraction they are discharged on the ova. The employment of a sperm-receptacle in *Cambarus* is a higher specialisation than the mode of indirect sperm-transfer in European species of *Astacus*. The nearest approximation would seem to be the sperm-receptacle of *Homarus americanus*, and that would seem to have been acquired independently. With the evolution of some sixty forms of sperm-transferring organs in the males there seem to have been evolved as many corresponding forms of annuli.

Decapods of the Red Sea.*—G. Nobili gives an account of the Decapoda and Stomatopoda of the Red Sea. Of Decapoda alone there are 183 genera and 451 species.

Mediterranean Cumacea.†—W. T. Calman reports on a collection of Cumacea made by the late F. A. Krupp in the neighbourhood of Capri. It is interesting to notice that of the 25 species recorded from depths exceeding 100 metres in the Mediterranean, 15 occur at corresponding depths off the West of Ireland. Some new species are described: *Cumellopsis puritani*, *Procampylaspis bonnieri*, *Campylaspis vitrea*, *C. spinosa*, and *Diastylis capriensis*.

Variation-Study on Atyaephyra desmarestii.‡—Arthur Brožek has made a biometric study of the variability of the upper and lower rostral teeth, of the paired denticles on the margins of the telson, and of the distal setæ of the telson. There is a *résumé* in German.

Life-History of Polyphemus pediculus.§—L. Keilhack finds that in the Krummen Lanke near Berlin this Cladoceran shows two reproductive periods in the year, one in June and a second in October. After the first formation of resting eggs the animals become scarce; they increase steadily towards the time of the second reproduction; in winter they are entirely absent. The short cycle is, as Ekman suggests, a reminiscence of the short Arctic summer; its repetition is an adaptation to a temperate climate.

Crustacea of the Forth Area.‖—Thomas Scott has published the second part of his catalogue—a noteworthy piece of careful faunistic work—dealing with 132 Ostracods, 306 Copepods, and 13 Cirripedia.

Polyandry of Scalpellum stearnsi.¶—P. P. C. Hoek points out that in this species—one of the largest forms of the genus—from shallow water off the coast of Japan, there is very pronounced polyandry. As a rule, the number of males found attached to the capitulum of the female or of the hermaphrodite is one at each side only; in some species it is two or three, and the largest number Hoek has observed is five. But in *Sc. stearnsi*, in which the large specimens with fully developed capitulum are females, the part of the sac or mantle which

* Ann. Sci. Nat. (Zool.) iv. (1906) pp. 1-192 (11 pls.).
† MT. Zool. Stat. Neapel, xvii. (1906) pp. 411-32 (2 pls.).
‡ SB. k. Böhm. Ges. Wiss., xi. (1904, received 1906) pp. 1-71 (1 pl.).
§ Zool. Anzeig., xxx. (1906) pp. 911-12.
‖ Proc. Roy. Phys. Soc. Edinburgh, xvi. (1906) pp. 267-386.
¶ Proc. Section of Science, k. Akad. Amsterdam, viii. (1906) pp. 659-62.

unites the two scuta behind or beneath the adductor muscle is covered with a crusty (Bryozoon-like) covering of over a hundred minute males. "Why did they choose for attachment a place which is less favourable for impregnation? Because they were so numerous and did not find space enough at the ordinary place."

Ostracodal Limestone.*—F. Chapman describes a rock from Durlstone Bay, Dorset (Upper Purbeck Series), which is interesting as a striking example of limestone almost entirely composed of the valves of Ostracoda—namely, species of *Cypridea*.

New Zealand Ostracoda.†—F. Chapman reports on a collection of Ostracods dredged off Great Barrier Island. Of the fourteen species noted, nine are new to the New Zealand area, and *Cytherideis hedleyi* is a new species. In the same paper he deals also with Foraminifera (*see* Protozoa).

Marine Copepods of Rhode Island.‡—L. W. Williams reports on a collection including twenty-six free-swimming Copepods, one parasitic form (*Argulus laticauda* Scott), and a metanauplius of a parasitic form (*Caligus* or *Lepeophtheirus*). The following new species are described: *Pseudo-diaptomus coronatus*, *Eurytemora americana*, *Tortanus setacaudatus*.

Copepods from Farther India, Sumatra, and Java.§—E. v. Daday reports on a collection of oriental Copepods, including *Cyclops asperi-cornis* sp. n., *Attheyella grandidieri* (Guern. Rich.), *A. decorata* (Dad.), *Nitocra platypus* sp. n., *Dactylopus jugurtha* Bl. and Rich., *Laophonte mohammed* Bl. R., and *Diaptomus visnu* sp. n.

New Species of Caligus.‖—P. Gadd describes *Caligus dentatus* sp. n., found in abundance by Einar Lönnberg on carp in the Caspian Sea. The female resembles *C. remoræ*, but has a very characteristic cephalothorax; the male resembles *C. branchialis*, and is somewhat larger than the female.

Parasite of Corynactis viridis.¶—A. Quidor describes *Mesoglicola delagei* g. et sp. n., which Professor Yves Delage found at Roscoff in the mesoglœa of *Corynactis viridis*. The body of the adult is elongated (7–8 mm.) and cylindrical, with distinct head, and indistinctly segmented thorax and abdomen. There are two pairs of antennæ with sharp hooks, short mandibles beside the siphon, and rudimentary maxillæ. The young occur isolated in the mesoglœa, the adults unite and form a whitish sub-ectodermic tumour on the *Corynactis*. The young are liberated as metanauplii. Infection is via the ectoderm, but endodermic infection is possible. In many respects this interesting new form recalls the Monstrillidæ.

* Proc. Geol. Assoc., xix. (1906) pp. 283–5 (1 pl.).
† Trans. New Zealand Institute, xxxviii. (1906) pp. 77–112 (1 pl.).
‡ Amer. Nat., xl. (1906) pp. 639–60 (23 figs.).
§ Zool. Jahrb., xxiv. (1906) pp. 175–206 (3 pls.).
‖ Arkiv. f. Zool., iii. No. 15 (1906) pp. 1–9 (9 figs.).
¶ Comptes Rendus, cxliii. (1906) pp. 613–15.

Annulata.

Behaviour of the Earthworm.*—H. S. Jennings inquires into the factors which determine the direction in which the earthworm moves. When a local stimulus is applied to one side of the anterior part of the earthworm, any one of the following varied methods of action may result: there may be merely a slight swelling of the region stimulated; the worm may turn the anterior end away from the side stimulated; it may turn the head towards the side stimulated; it may creep backward, or forward, or first backward and then forward; the head may be merely retracted; the animal may make a sudden right-about-face, interchanging the position of anterior and posterior ends; the anterior fourth of the body may be raised in the air and waved wildly about. At least nine different methods of behaviour may follow the stimulus. What are the determining factors?

The following groups may be distinguished:—A. External factors: (1) intensity of the stimulation, (2) localisation of the stimulus. B. Internal factors: (3) the reaction depends partly on what the animal has done, and on its position, just before receiving the stimulus; (4) the reaction depends partly on the general tendency of the animal to move in a certain way, namely, forward rather than backward; (5) the reaction depends partly on the direction in which the animal is crawling at the moment when it is stimulated; (6) the reaction depends partly on previous stimuli received, according as the earthworm is in a state of rest, or of moderate activity, or of excitement, of which there are many different degrees.

"The movement at a given time demonstrably depends, not alone on present external conditions, but also on former external conditions, former actions of the organisms, and present internal physiological conditions that are determined in many different ways. The direction of movement of one of these organisms cannot be represented as a simple function of the direction of impact of some external force, but is the complex resultant of many different factors."

As in his experiments on Infusorians, so here Jennings finds evidence that stimulation causes varied movements, which do not all lead toward the condition finally attained, and that those movements which do lead towards this final condition (the "optimum") are followed up more decidedly than the others. The behaviour may perhaps be most accurately characterised as "selection from among the conditions produced by varied movements."

Maturation and Fertilisation in Saccocirrus.†—F. Hempelmann describes the processes of oogenesis, maturation, and fertilisation in *Saccocirrus papillocercus*, and finds that they follow the regular routine. One remarkable fact, however, is that the spermatozoa pass by a direct route of communication between the receptaculum and the ovary, that they make their way into the latter, and penetrate even half-ripe oocytes.

* Journ. Exper. Zool., iii. (1906) pp. 435–55 (1 fig.).
† Zool. Anzeig., xxx. (1906) pp. 775–84 (19 figs.).

Development of Protodrilus and Saccocirrus.*—Umberto Pierantoni describes the early stages of development, and the formation of the larva in these two archiannelids.

Pelagosphæra aloysii.†—Angelo Senna gives a careful description of this pelagic form, and comes to the conclusion that it is simply a larval stage in the development of *Sipunculus*.

Revision of the Naididæ.‡—E. Piguet has studied the Swiss Naididæ (28 species), and gives a diagnostic key and a systematic revision. The various genera—*Paranais*, *Chætogaster*, *Ophidonais*, *Naidium*, *Nais*, *Dero*, etc., are passed under review. The influence of the seasons on the manner of life, the coloration, the budding, and the sexual reproduction is illustrated.

Naididæ of North America.§—L. B. Walton describes the Naids of Cedar Point, Ohio, and gives synoptic tables for the separation of the genera of this family, and similar tables of species for the genera represented. Five genera are dealt with in detail, and seven new species are described.

Maturation-processes in Ophryotrocha puerilis.‖—A. and K. E. Schreiner describe the processes of maturation in the oogenesis and spermatogenesis of this Annelid. The processes agree entirely with what the authors have described in *Tomopteris*.

Sex-Determination in Dinophilus apatris.¶—Hans Freiherr von Maisen finds that in this primitive worm sex-determination occurs in the ovary and depends on the nutrition of the ovocytes. The better the nutritive conditions the more "female" ova are produced. The influence of temperature is not direct, it operates by favouring or inhibiting the nutritive conditions. In general the nutritive conditions are most important, but it is not to be supposed that throughout the animal kingdom this is the only sex-determining factor. There are several co-operative factors, and the period of sex-determination varies from case to case.

Nematohelminthes.

Abnormalities of Sex Organs in Ascaris.**—H. Balss describes in *Ascaris lumbricoides* a tripartite uterus, all the divisions of which produced eggs in a normal manner. W. Harms records a case of a female *Ascaris megalocephala*, in which the uterus is unpaired, and an example of an *Ascaris* of undetermined species, also a female, in which the vaginal opening occurs upon the left side in a dorso-lateral position, at the usual distance from the anterior end.

* MT. Zool. Stat. Neapel, xvii. (1906) pp. 515–23 (2 figs.).
† Raccolte Planctoniche (R. Ist. Stud. Sup. Firenze) ii. (1906) pp. 53–78 (2 pls.).
‡ Rev. Suisse Zool., xiv. (1906) pp. 185–316 (4 pls.).
§ Amer. Nat., xl. (1906) No. 478, pp. 683–706 (12 figs.).
‖ Anat. Anzeig., xxix. (1906) pp. 465–79 (17 figs.).
¶ Arch. Mikr. Anat., lxix. (1906) pp. 63–99 (1 pl.).
** Zool. Anzeig., xxx. (1906) pp. 485–8.

Spermatozoa of Ascaris.*— H. Marcus describes the peculiar spermatozoa of *Ascaris lumbricoides*, and calls attention to the numerous pseudopodia which make the spermatozoon sometimes Heliozoon-like. He observed the gradual penetration of the ovum, and suggests (with Zacharias) that a fermentative action may perhaps dissolve the membrane. He also discusses the apparently unimportant "refractive body," the chromatoid granules around the nucleus, and the probable concealment of a centrosome within the chromatin-nucleus.

Trichosoma tenue in Liver of Erinaceus.†—B. Galli-Valerio describes from the liver of *Erinaceus europaeus* eggs and adults of this Nematode obstructing the lumen of the biliary canal. The walls were thickened, and at certain places the parenchyma of the liver was replaced by eggs surrounded by connective tissue. The liver had the appearance of suffering from miliary tuberculosis, but microscopic examination revealed the true cause of the lesions.

Pathogenic Action of Intestinal Worms.‡—J. Guiart thus sums up the modes of action of gut parasites. They may through stimulation of nerve endings institute reflex disturbances, causing sickness. By secretion of substances more or less toxic, red blood corpuscles may be destroyed or nerve centres affected. By causing ulceration of the mucous membrane, an opening is made for the entrance of toxins and bacteria. It appears from the facts adduced that intestinal worms play an important part, especially in tropical pathology.

Platyhelminthes.

Multiple Echinococcus in Body Cavity of Man.§—Dr. Kablukoff gives an account of six cases where numerous echinococcus vesicles were present in the body cavity. Four of the patients died. The author is of opinion that the presence in the body cavity of the echinococci was due to the rupture of a cyst or cysts.

Development of Tænia serrata.‖—C. V. Janicki gives an account of the early stages in the development of this tapeworm—the immature ovum (with its chromidial apparatus (?)), the yolk-cells, the segmentation into macromeres and micromeres, the formation of the egg-envelope, and so on.

Life-history of Trematodes of Fishes and Amphibians.¶—D. Ssinitzin has made an important series of observations on *Distomum cygnoides* (which he calls *Gorgodera loossi*) of *Rana esculenta* and *R. temporaria*, which has *Epitheca* larvæ as its intermediate host, and on other Trematode parasites of frogs. He also discusses *Phyllodistomum*

* Biol. Centralbl., xxvi. (1906) pp. 427–30 (5 figs.).

† Centralbl. Bakt. Parasitenk., xli. (1906) pp. 746–7 (1 fig.).

‡ Arch. de Parasitol., ix. (1904) pp. 175–86. See also Centralbl. Bakt. Parasitenk., xxxviii. (1906) pp. 215–16.

§ Arch. f. Klin. Chir., lxxviii. (1905). See also Centralbl. Bakt. Parasitenk., xxxviii. (1906) p. 218.

‖ Zool. Anzeig., xxx. (1906) pp. 763–8 (7 figs.).

¶ Zool. Zentralbl., xiii. (1906) pp. 681–9.

folium of various fishes, which has its first intermediate host in *Dreissensia polymorpha*. He proposes a genus *Gorgoderina* for Trematode parasites of the ureter and bladder of fishes, and *Gorgodera* for Trematode parasites of the bladder of frogs. The original paper is in Russian, but a full summary will be found in German under the reference.

Land Planarian in Ohio.*—L. B. Walton records the occurrence of a species of *Rhynchodemus* at Gambier, Ohio, which differs in many particulars from *R. sylvaticus*, the only terrestrial planarian hitherto described from the United States.

Incertæ Sedis.

Rhabdopleura.†—C. Vaney and A. Conte discuss the structure, budding, and affinities of *Rhabdopleura normani*. They do not find any definite septum between the three regions of the animal. As to the cœlom, all that can be said is that between the body-wall and the internal organs there are connective cells, separated by lacunæ more or less developed. They do not find any collar pores or prostomial pore, and they do not believe in the "notochord." They failed to find a cardiac vesicle. There is no evidence that the so-called central nervous system is really nervous. The branchial grooves cannot be homologised with gill-clefts. There is no skeletal tissue. The ovary, hitherto undiscovered, lies at the base of the retractile stalk and develops at the expense of the axial portion of the same. The nearest affinities of *Rhabdopleura* are with the Endoprocta.

Larval Nephridia of Phoronis.‡—Crosswell Shearer shows that in the young larva of *Phoronis* the nephridia develop as outgrowths of the diverticula into which the ectodermic nephridial or anal pit divides, and that the solenocytes arise as direct outgrowths of certain cells of the sides and ends of the nephridial canals. Nephridia and solenocytes are therefore of ectodermic origin.

In early stages the nephridial canals are long and slender openings at the posterior end of the larva on either side of the anus. During development the canals shorten and thicken, and their external openings move forward until in the Actinotrocha larva they open behind the ring of tentacles on the anterior end of the trunk, where they project inwards and forwards between the preseptal cœlom and the gut wall, into the hæmocœlic space of the collar region. They are closed, never communicating with the blastocœlic space in which they lie. During metamorphosis the canals of the larval organs persist as the canals of the adult nephridia, which acquire openings into the cœlom by means of ciliated funnels of unknown origin. The main cœlomic cavity of the larva, the body cavity of the adult, appears a little after the nephridia as a small space on the dorsal side of the rectum, and is from the first unpaired. Only after metamorphosis do the nephridia come into relation with it.

* Ohio Naturalist, v. (1905) No. 3, p. 254.
† Rev. Suisse Zool., xiv. (1906) pp. 143–83 (4 pls.).
‡ MT. Zool. Stat. Neapel, xvii. (1906) pp. 487–514 (3 pls.).

New Mesozoon.*—V. Dogiel describes *Haplozoon armatum* g. et sp. n., which represents a new group of Mesozoa. It was found abundantly in the anterior part of the intestine of an Annelid, *Travisia forbesi*, attached to the wall. The youngest stage consisted of a single spindle-shaped cell, with an anterior attaching apparatus. From this unicellular stage there developed by nuclear division a two-celled stage. Beneath the hard stilet there was a tuft of contractile pseudopodium-like attaching filaments issuing from a single opening in the cuticle of the anterior cell. More cells are divided off from the anterior cell, and as each new cell is formed the others divide. Thus an elongated single-layered animal with a few oblique rows of cells is formed. The largest specimen was 0·5 mm. in length, and consisted of 56 cells. The 2–6 cells at the posterior end become full of refractive bodies, and each divides into four. These are the germ-cells, and they are liberated in pairs into the lumen of the Annelid's gut.

Echinoderma.

New Californian Starfishes.†—W. K. Fisher describes from Monterey Bay, California, *Astropecten californicus* sp. n., a long-rayed form, with numerous actinal adambulacral spines. The infero-marginal plates are narrow, with a transverse aboral series of about three spines on the edge of the ray, and with auxiliary spinules. *Alexandraster inflatus* sp. n. is also recorded from the same area. It has short and thick rays, and strongly grooved adambulacral spines. The furrow spines are prominent, and not conspicuously smaller than those of the actinal surface.

Commensals of Echinoderms.‡—Ch. Pérez notes that the burrows of *Synapta* often contain a Polychæt (*Ophiodromus flexuosus*, one of the Hesionidæ) and an Amphipod. The Polychæt has been hitherto known only as a commensal of *Astropecten*, and the Amphipod as a commensal of the burrowing Spatangid *Echinocardium cordatum*. Thus the usual constancy of commensal association is not without exceptions. Hitherto, however, *Acholöe astericola* has only been found on *Astropecten*.

Species of Pseudocucumis and Phyllophorus.§—Hjalmar Östergren seeks to get at the facts of the case in regard to *Pseudocucumis mixta* Östergren, *Phyllophorus pellucidus* Fleming, and *Ph. communis* v. Düben and Koren, which seem to have a perplexing synonymy.

Cœlentera.

Alcyonarians from Zanzibar.‖—J. Arthur Thomson and W. D. Henderson report on a collection of littoral Alcyonarians made by Mr. Cyril Crossland at Zanzibar. The collection includes over 60 species, of which 25 are new. The most interesting new forms in the collection are the following:—*Clavularia pregnans* (viviparous), *Siphonogorgia intermedia* (an annectent type), *Cœlogorgia reptans* (with encrusting

* Zool. Anzeig., xxx. (1906) pp. 895–9 (9 figs.).
† Tom. cit., pp. 299–302.
‡ Proc. Verb. Soc. Sci. Bordeaux, 1904–5, pp. 57–8.
§ Arkiv. f. Zool., iii. No. 16 (1906) pp. 1–23 (3 figs.).
‖ Proc. Zool. Soc. London, 1906, pp. 393–443 (6 pls. and 1 fig.).

habit), *Virgularia multicalycina*, *Pteröeides rigidum*, and *Pt. pulchellum*. Attention is given to the great variability of the species of *Clavularia* and *Xenia*, e.g. as to the number of rows of pinnules, the number of pinnules, the bare streak on the tentacles, the spicules, and so on. Mr. Crossland adds notes on the localities.

Deep-Sea Alcyonarians from Indian Ocean.*—J. Arthur Thomson and W. D. Henderson report on a collection of Deep-sea Alcyonarians made in the Indian Ocean by the Royal Indian Marine Survey Ship 'Investigator.' The collection includes 86 species, of which 61 are new. There are 6 new Stolonifera, 8 Alcyonacea, 3 Pseudaxonia, 22 Axifera, and 22 Stelechotokea. It has been found necessary to establish five new genera—*Stereacanthia* and *Agaricoides* (separately described by J. J. Simpson) in the family Nephthyidæ, sub-family Siphonogorginæ; *Acanthomuricea* and *Calicogorgia* in the family Muriceidæ; and *Thesioides* in the family Kophobelemnonidæ.

Some of the new species are of considerable interest, e.g. a stalkless form of *Sarcophytum aberrans* growing on a huge sponge spicule (300 mm. in length by 2–3 mm. in breadth); *Chironephthya macrospiculata* with spicules over 8 mm. in length; *Protocaulon indicum*, a new member of the genus hitherto represented only by Kölliker's *P. molle*; and so on.

Embryos have been found *in situ* in eight cases, so that the list of viviparous Alcyonarians is greatly increased. In the notes on geographical distribution the widespread occurrence of some deep-sea types is well illustrated. Some of the epizoic animals are interesting, e.g. a peculiar Solenogaster, *Rhopalomenia gorgonophila* (?), on *Acamptogorgia circium* sp. n.

Primary Septal Plan of the Rugosa.†—R. G. Carruthers finds from a study of *Zaphrentis* and other lower Palæozoic corals that the primary septal plan of these Rugosa is hexamerous, and is arrived at by an insertion of bilateral pairs analogous to that occurring in the soft parts of the rest of the Madreporaria. Thus, the Rugosa come into closer association with modern corals, and the idea must be dismissed that they are primarily tetramerous.

Fragmental Fission in Metridium marginatum.‡—M. L. Hammatt finds that this occurs frequently in nature. From a study of sections it is inferred that the body becomes bilaterally symmetrical before the fragmental fission takes place, this occurring always, as far as observed, on the larger side, and that the fragment thus cut off includes body-wall (formed on the side next the parent by infolding of the parent body-wall), and parts of directive and other mesenteries on one side only of the plane of symmetry of the parent animal. The infolding is essentially like the constriction which separates the Hydra bud

* An Account of the Alcyonarians collected by the Royal Indian Marine Survey ship 'Investigator' in the Indian Ocean. I. The Alcyonarians of the Deep Sea. Printed by order of the Trustees of the Indian Museum. Calcutta, 1906, xvi. and 128 pp., 10 pls.

† Ann. Nat. Hist., xviii. (1906) pp. 356–63 (1 pl.).

‡ Amer. Nat., xl. (1906) pp. 583–91 (2 pls.).

from its parent, but the basal attachment slightly modifies the process. The fragment cut off curls together until its extremities meet, making parts of mesenteries before nearly parallel now radial in arrangement, thus attaining the sea-anemone structure with the least expenditure of energy.

Development of Cunina proboscidea.* — J. Stschelkanowzew has been able to work out the development of this Medusa. It seems likely that its life-history is complicated by the occurrence of two distinct generations. The one leads a parasitic life, complicated by the budding of its larval stage and the consequent formation of colonies. From the ova of the Medusæ which are produced by these colonies, the second rudimentary generation develops (in their endoderm and gastro-vascular cavity), and eventually infects *Carmarina hastata*.

Hydra orientalis.†—Nelson Annandale describes this new species of *Hydra* from Bengal. It is related to *H. grisea*, which it resembles in the structure of its normal egg. The number of tentacles differs at different seasons in different generations. Comparatively few buds are produced. Vertical fission occasionally occurs. The species is diœcious. A rise in temperature induces a proportion of the individuals in an aquarium or a pond to develop testes; if considerable, it may induce a few of those that remain to produce eggs. As a result of exhaustion eggs are sometimes produced which do not secrete a horny outer shell. Individuals are short-lived and perish after sexual reproduction, several generations being completed in a year.

The Indian species is more delicate than the European forms. It is far from plastic to changed conditions, and heat is most inimical to its life. It moves away from light, probably because it is repelled by heat. It progresses chiefly by crawling. The colour is due to solid particles in the endoderm derived from the food, and in unfavourable conditions the polyp may lose its colour.

Bionomical Relations of Hydra orientalis.‡—Nelson Annandale notes that unicellular Algæ settle on the surface of *Hydra orientalis*—this might be the beginning of symbiosis. What seems to be *Vorticella monilata* was found attached in groups to the body of the polyp. The polyp is not infrequently attached to the shell of *Paludina*, which is undoubtedly useful to the Hydra. A chironomid larva feeds on *Hydra orientalis*. The oriental Hydra feeds in the early morning—on Cladocera, Copepoda, Rotifers, minute Oligochæta, and insect larvæ.

Budding and Sexual Reproduction in Hydra fusca.§ — Richard Hertwig has made a careful study of this fresh-water polyp. It is distinctly male or female. A distinction between a stalk and a pigmented body is very marked. There is a definite rhythm in the budding. The buds appear one above the other at regular distances. This depends on nutritive conditions. The similarity between the early stages of buds

* MT. Zool. Stat. Neapel, xvii. (1906) pp. 433–86 (2 pls.).
† Mem. Asiatic Soc. Bengal, i. No. 16 (1906) pp. 339–59.
‡ Journ. Asiatic Soc. Bengal, ii. (1906) pp. 109–16.
§ Biol. Centralbl., xxvi. (1906) pp. 489-508.

and the early stages of oogenesis is emphasised. The question of the factors determining gemmation or sexual reproduction is discussed. There is a correspondence between a constitutional "depression" of the polyp and the development of gonads.

Porifera.

New Desmacidonidæ.*—W. Lundbeck reports on some of the Desmacidonidæ (the Esperellinæ, *seu* Mycalinæ) of the 'Ingolf' Expedition, discussing 14 genera and 69 species, of which 32 are new. Considerable attention is paid to the characterisation of the chele and anchor spicules.

Development of Sycandra raphanus.†—E. Hammar found sexually mature individuals at every season of the year at Naples. The ova arise from amœboid wandering cells in the middle stratum, and devour other amœboid cells. After the larvæ fix themselves, an indefinite middle stratum appears. It did not seem as if the spicules had an intra-cellular origin. The flat epithelium lining the oscular-tube and the proximal parts of the radial chambers seemed to be endodermic in origin, as if modified from the flagellate cells of the larva. The latter seem to have no collar. Like the collar-cells of the adult, they have a distinct blepharoplast from which the flagellum springs. In well-preserved material Hammar could not find Sollas's membranes, rod-like structures in the collar, or iris-like basal diaphragms.

New Siliceous Sponges from Africa.‡—L. Baer reports on four species of Tetraxonida, and sixteen species of Monaxonida (of which fifteen are new), from Zanzibar, Cape Town, and Papeete.

Sponge Spicules.§—Celso Arevalo has made some optical investigations on the siliceous and calcareous spicules of Spanish sponges, e.g. of *Leuconia*, and propounds a theory of their mode of formation.

Protozoa.

Chemical Nature of Acantharian Skeleton.‖—O. Bütschli finds that the skeletal substance of *Podactinelius* and other Acantharia consists mainly of strontium sulphate, probably in the form of cœlestin or the like.

Studies on Acanthometridæ.¶—W. Mielck communicates some of the results of his studies on Pacific Ocean Acanthomethridæ, especially as regards the skeleton—the number and arrangement of the spines, the central union of the radial spines, the cross-sections of the spines, and so on. The genus *Acanthonia* seems to represent the phyletically oldest group of Acanthometridæ with radial spines.

* Danish 'Ingolf' Exp., vi. part 2 (1905) pp. 1–219 (20 pls. and 7 figs.).
† SB. Ges. Natur. Berlin, No. 5 (1906) 4 pp. See also Zool. Zentralbl., xiii. (1906) pp. 451–2.
‡ Arch. Natur., lxxii. (1906) pp. 1–36 (5 pls.).
§ Boll. Soc. Españ. Hist. Nat., vi. (1906) pp. 368–75 (3 figs.).
‖ Zool. Anzeig., xxx. (1906) pp. 784–9.
¶ Tom. cit., pp. 754–63 (3 figs.).

Studies on Sarcodina.*—E. Penard describes various Swiss Sarcodina—*Amphizonella violacea* Greeff, *Zonomyxa violacea* Nüsslin, *Placocystis glabra* sp. n., and other forms.

Multinucleate Amœbæ.†—A. Štolc describes the occurrence of multinucleate forms of *Amœba proteus* when the conditions of culture are altered (either scarcity or superfluity of food). The multinucleate forms arise either by multiplication of nuclei or by the fusion of several uninucleate individuals. They give rise by division to normal uninucleate forms. The author calls the phenomenon "plasmodiogonie."

New Zealand Foraminifera.‡—F. Chapman reports on a collection of Foraminifera dredged off Great Barrier Island. The sounding was remarkable for the extraordinary abundance of specimens of *Biloculina*, *Nodosaria*, *Cristellaria*, and *Truncatulina*, and their full development is indicative of especially favourable conditions of life in this particular area. Another interesting feature is the presence of a large number of forms which have hitherto been found in dredgings from other, widely removed areas, generally in the northern hemisphere, and particularly from the colder waters of the Temperate Zone. The author enumerates 103 species, of which 57 are new to this area, and *Brachysiphon corbuliformis* is a type of a new genus. In the same paper he deals also with Ostracods (see CRUSTACEA).

Genus Actinolophus.§—L. B. Walton gives a review of the species of this genus of Heliozoa, and describes a new form, *A. minutus* sp. n., from Gambier, Ohio, the first of this group to be recorded for America.

Treponema pallidum Penetrating the Ovum.‖—Levaditi and Sauvage report a case in which this spirochæte had penetrated into the ovarian ova of a child. According to R. Koch the spirillum of tick-fever may infect the ovum of *Ornithodoros moubata*; according to Levaditi and Manuélian, *Spirillum gallinarum* may penetrate the ova of infected fowls. It seems, therefore, that there may be infection of ova from a syphilitic mother, quite apart from placental infection of the fœtus.

Note on Treponema pallidum.¶—B. Galli-Valerio confirms the observations of other workers that the appearance of this parasite may be greatly altered in preparations fixed over the flame. The spirals are more open and the typical characters lost. This is especially so if the preparation is warmed before drying. Its most reliable distinguishing feature is its thinness and its staining reddish with Giemsa's preparation.

Spirochæta pallida in Syphilitic Sections.**—E. Bertarelli and G. Volpino record the occurrence of *Spirochæta pallida* in sections of primary, secondary, and tertiary syphilitic lesions. Some of the

* Rev. Suisse Zool., xiv. (1906) pp. 109–41 (1 pl.).
† Arch. Entw., xxi. (1906) pp. 111–25. See also Zool. Zentralbl., xiii. (1906) pp. 586–7.
‡ Trans. New Zealand Institute, xxxviii. (1906) pp. 77–112 (1 pl.).
§ Ohio Naturalist, v. (1905) No. 3, pp. 261–3.
‖ Comptes Rendus, cxliii. (1906) pp. 559–61 (1 fig.).
¶ Centralbl. Bakt. Parasitenk., xli. (1906) pp. 745–6 (1 fig.).
** Tom. cit., pp. 74–8 (1 pl.).

organisms showed distinct terminal swellings. They observed also in a few cases in the lymph spaces or within cells black or yellow corpuscles, which may be resting stages of Spirochætæ, but this is doubtful.

Trypanosomata of Gambian Fever and Sleeping Sickness.*—H. Wolferstan Thomas finds that the parasites of these diseases are identical with *T. gambiense*. This conclusion is come to after over 1000 experiments, nearly 600 of which were on rats. The resulting symptoms after infection are similar, and the parasites in the normal condition cannot be distinguished from each other. These results are directly opposed to the conclusions previously published by H. G. Plimmer.

Suspected New Human Trypanosome.†—Kudicke found Trypanosomes in the blood of a *Cercopithecus* into which had been injected blood from a fever patient from the south coast of Victoria Nyanza. The parasites appeared after seventeen days. Inoculation of other Cercopitheci gave negative results. The trypanosome resembles *T. theileri* which, according to Theiler, occurs only in cattle. Whether, this is a new species is, however, at present undecided.

Trypanosome of Dourine Introduced into Ruminants and Monkeys.‡ F. Mesnil and J. Rouget have shown that the Trypanosome of Dourine, in spite of previous statements, may be introduced into Ruminants and monkeys. There is not in this respect any contrast between dourine and other forms of Trypanosomyasis in Algeria.

Flagellates from the Intestine of Diptera.§—A. Lingard and E. Jennings give descriptions of flagellate and other forms found in *Musca domestica*, *Stomoxys calcitrans*, and a species of *Culex*, grouping them according to locality, thus:—(1) Those from the plains of the United Provinces, India; (2) from the Himalayas at an elevation of 7500 ft. above sea level (Muktesar). In addition there is a detailed account of numerous flagellate organisms discovered in the body cavity of a fly (species undetermined), together with a record of the results obtained after feeding the common house-fly on mouldy wheat. These last experiments yielded a number of parasites, the majority of which were traceable to the wheat. The authors make the suggestion, based in part upon their results, that rice may harbour Protozoa or other organisms, and offer hints as to the investigation of beri-beri as possibly communicated by this cereal, particularly if the rice is of inferior quality or has been lying in bulk prior to or during the rainy season.

Culture of Coccidium hominis.‖—B. Galli-Valerio finds that the spores of *Coccidium hominis* develop upon the agar of Nissle and Wagener. In two days they show segmentation, and in seven or eight days the majority of the coccidia show merozoites already formed. By adding now and again a little water the culture may be kept for months.

* Proc. Roy. Soc., Series B, lxxviii. No. B 525 (1906) pp. 316–17.

† Centralbl. Bakt. Parasitenk., xli. (1906) pp. 72–4 (1 pl. and 1 fig.).

‡ Ann. Inst. Pasteur, xx. (1906) pp. 689–97.

§ Some Flagellate Forms found in the Intestinal Tract of Diptera and other Genera. London: Ardlard and Son, 1906, pp. 1–25 (5 pls.).

‖ Centralbl. Bakt. Parasitenk., xli. (1906) p. 745.

Myxosporidia in Spinal Cord of Trout.*—A. Schuberg and O. Schröder describe from the brook trout a new species of *Myxobolus*. It occurred in the peripheral nerves and spinal cord. The cysts are mostly long, ·9 mm. by ·2 mm. and lie always between the sheath of Schwann and the medullary sheath of the nerve fibres. The spores measure 10–12 μ by 8 μ by 6 μ. In the same trout was found in the connective tissue beneath the dorsal fin an example of a species of *Henneguya* whose spore plasma exhibited one nucleus only.

Nosema in Shore-Crab.†—Ch. Pérez finds a species of *Nosema* very abundant throughout the musculature (excepting the heart) of *Carcinus mænas*. In the same animal and in the same tissues he recently found the Microsporidian *Thelohania mænadis*, but in several thousand crabs he found only one in which the two parasites were present together.

New Glugea in Acorn-Shell.‡—Ch. Pérez describes *Glugea stempelli* sp. n., abundant in *Balanus amaryllis*. Its life-history is similar to that of *Glugea anomala* Mon. Very characteristic is the successive sporulation in the interior of a large trophozoite with budding nuclei.

Nucleus of Aggregata.§—Th. Moroff discusses the peculiar digenetic Gregarines belonging to Frenzel's genus *Aggregata*, which have their asexual development in the intestine of various crabs and their sexual stages in the intestine of Cephalopods. A remarkable feature is the variety in the division of the nucleus, for no fewer than seven modes are reported—possibly characteristic of different species. In most cases the divisions of the nucleus take place below the surface of the parasite; thereafter the nuclei project on the surface covered by a thin plasmic layer.

* Arch. f. Protistenk., vi. (1905) pp. 47–60 (1 pl.).
† Proc. Verb. Soc. Sci. Bordeaux, 1904–5, pp. 16–18.
‡ Tom. cit., pp. 28–9.
§ Zool. Anzeig., xxxi. (1906) pp. 72–8.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Study on Synapsis and Reduction.*—I. Cardiff has examined the mitoses in the sporogenous tissue of *Acer Platanoides*, *Salomonia biflora*, *Ginkgo biloba*, and *Botrychium obliquum*, and is led to the following conclusions. The synaptic knot is a constant morphological character of the mother-cell, and is always in contact with the nucleolus. Its position is probably due to gravity. The nucleus increases in size up to the time of synapsis, and there is a marked difference in the appearance of the pre-synaptic and post-synaptic chromatin. Prior to synapsis the chromatin forms into threads, which arrange themselves in pairs longitudinally, move together, and finally fuse during synapsis. In this fusion the chromomeres generally fuse in pairs, but there is probably not a complete intermingling of chromatin in the bivalent thread. The latter splits longitudinally in the first mitosis, probably along the line of previous fusion.

Synapsis is a stage of great chemotactic activity, and may be regarded as the end result of fertilisation. The author thinks that in fertilisation there is a nuclear, but not a chromatin fusion, but that the paternal and maternal elements retain their identity throughout the sporophytic existence of the plant, finally fusing during synapsis.

Phycocyanin.†—H. Molisch exposes the erroneous theory that Cyanophyceæ all possess one and the same phycocyanin, and shows that there are at least three, and probably more phycocyanins. They represent very closely-allied albuminous bodies, which are, however, easily distinguished from one another by the colour of their aqueous solutions, the colour of their fluorescence, their power of crystallisation, and their spectroscopic properties. The author gives instances of Cyanophyceæ which have the different forms of phycocyanin, and states that though many factors undoubtedly take part in the production of the different colours of the algæ of this group, there can no longer be any question that one of these factors is the difference of phycocyanin. An interesting note is made concerning *Porphyridium cruentum* Nägeli, which is found by the author to possess no phycocyanin, but only crystallisable phycoerythrin. This is the only known instance of this colouring matter in an aerial alga, and the discovery supports the views of Schmitz and Gaidukov as to the relationship between *Porphyridium* and the Bangiales.

* Bull. Torrey Bot. Club, xxxiii. (1906) pp. 271–306 (4 pls.).
† SB. k. Akad. Wien, cxv. (1906) 2 pls.

Structure and Development.

Vegetative.

Leaf-structure and Physical Factors.* — Edith S. Clements has investigated the relation of leaf-structure to physical factors. Her experiments were made with typical hydrophytes, mesophytes, and xerophytes, and she draws the following conclusions. Typical mesophyll consists of equal amounts of palisade and spongy tissue and moderate air-spaces; in hydrophyll the palisade-cells are absent, while in xerophyll there are no palisade-cells, few air-spaces, and water-storage tissue often occurs. Decreased light and increased water supply cause increase of leaf-surface and decrease of thickness, the converse also being true. The response of chlorophyll to light is the indirect cause of the variation in the thickness of the leaf. The varying shapes of the cells is due to the different arrangements of the chloroplasts in different lights. Decreased light and increased water supply produce looseness of cell-formation, and *vice versâ*. Also, since a covering of woolly hairs decreases light and transpiration, this likewise results in loosely-formed tissue. Humidity affects water-content and causes a change in the cuticle. Temperature has an indirect effect, owing to its relation to humidity. Plants are affected by the low humidities and short seasons of high regions, and are dwarfed by extremes of any factor. Plasticity varies with different species, the Compositæ showing the greatest stability. No law can as yet be found as to the exact variation in the histology of the leaf with definite differences in physical factors, for while in plastic species it may be proportional, epidermal and morphological modifications must also be considered.

Life-history of Neottia.† — G. Peklo has investigated the life-history of *Neottia nidus-avis*, and finds that the shoot-formations which occur normally in the life-cycle of this orchid serve the purpose of vegetative reproduction. These shoots are set free by disturbance of the parts overlying the root-axis of the nest and its side-roots, and usually by the loosening of the connection between these parts, which loosening, in extreme cases, results in the destruction of the nidus, in which there are still sufficient elements for a longer life. The mycorrhiza-fungus is transmitted by the parent-plant to its descendant, but it is possible, nevertheless, to induce it to thrive upon an artificial, nourishing substratum, and thus to cultivate it apart from its host.

Reproductive.

Embryology in Hieracium.‡—O. Rosenberg has studied the embryology of *Hieracium*, and finds that in most seeds the tetrad-formation is accompanied by a reduced number of chromosomes, and a few of the embryo-sacs thus formed attain full development, being thus quite normal. In general, however, the normal embryo-sac is crowded out and an aposporous one formed. In exceptional cases, e.g. *Taraxacum*, an apogamous embryo-sac is developed. In both of these latter cases

* Trans. Amer. Micr. Soc., xxvi. (1905) pp. 19–94 (9 pls.).
† Flora, xcvi. (1906) p. 260–75 (2 figs.).
‡ Ber. Deut ch. Bot. Gesell., xxiv. (1906) pp. 157-61 (1 pl.).

the oospheres are formed without reduction of the chromosomes, and develop into embryos without being fertilised. In *H. excellens* and *H. flagellare* the embryo-sac formation somewhat resembles that of *Thalictrum purpurascens*, but in most seeds apospory also occurs. The embryo-sac formations in these plants is noteworthy as being different from those of any other previously described parthenogenetic plants.

Post-floral Growth of Sepals in Convolvulaceæ.*—N. Svedelius has studied the calyx in a few Convolvulaceæ with special reference to its development into a water-cup. In this connection he has also examined the epidermal hairs which in this family often assume secretory functions. Secretion, which is most marked in the fruiting stage, almost always accompanies a more or less vigorous post-floral growth of the sepals, but in no type is it so great as in *Stictocardia*, where the fruit ripens in a water-bath, surrounded by the greatly enlarged sepals. Here the secretion is of a watery nature, but in *Operculina* and *Ipomœa alata* and *I. tuberosa* mucus is secreted.

The function of the post-floral calyx and the accompanying secretion is to form a protection against the drying which would result from such strong insolation as that to which the liane-like Convolvulaceæ, e.g. *Stictocardia*, are exposed. Where the sepals are strongly developed the fruit-walls are thin and soft, e.g. various species of *Dillenia*. There is much variation in the post-floral development of the sepals, which may be simply folded together, or may be entirely or partly thickened. In *Porana* and in some species of *Ipomœa*, the sepals form wings for the fruit, while in *Cardiochlamys* they form a bladder-like covering.

Where secretion occurs, all the sepals may be involved in it, as in *Stictocardia*, or it may be confined to the inner ones as in *Operculina*, where the three inner sepals are secretory and the outer ones are protective.

Glandular hairs similar to those on the sepals may also occur on the foliage-leaves, being confined to the lower surface. The hairs on the outer side of the protective sepals are like those on the upper surface of the foliage-leaves, and are probably hydathodes.

Sexual Differentiation.†—A. F. Blakeslee has investigated the differentiation of sex in thallus gametophyte and sporophyte, especially among the Mucorineæ. He finds that the "homothallic" forms are anisogamous, but that the "heterothallic" forms are isogamous. It is probable that isogamous "homothallic" forms have given rise to two lines of descent, viz. anisogamic, homothallic forms, and isogamous, "heterothallic" forms. At present no theory can be formulated as to origin of sexuality in the group. Where there is difference in vegetative growth, the + strain is more luxuriant, but the reason for this is not evident, since the zygote is suspended midway between the two thalli. The sexes are mutually attractive, but it is not yet proved that the terms male and female may be substituted for + and −. The author then draws a comparison, from the sexual point of view, between the Mucorineæ, Bryophyta, Pteridophyta, and Phanerogams, and arrives at

* Flora, xcvi. (1906) pp. 231–59 (31 figs.).
† Bot. Gazette, xlii. (1906) pp. 161–78 (1 pl. and 3 figs.).

the general conclusion that the so-called unisexual forms have one sex dominant, while the other is suppressed (i.e. in latent condition); but there is a possibility that in certain stages and in certain plants, a single sex may exist in a pure condition. Certain cases suggest that sex may be pure in the gametophyte, while mixed in the sporophyte.

Physiology.

Nutrition and Growth.

Development of Green Plant in Absence of Carbon Dioxide.—M. J. Lefèvre * continues his series of papers upon green plants grown upon an amide soil in the absence of CO_2. The author, after remarking upon the part played by amides as materials for reserve, construction, food-material, and transport agents, proceeds to describe the apparatus used in his experiments, also the preparation of culture-soils and the choice of suitable plants. He then shows that valeric, butyric, propionic, and uric amides are unsuitable for these experiments, while the best results are obtained from a mixture of tyrosin, glycocol, alanin, and leucin, provided that the total amount of these substances does not exceed 1·5–2 grm. per 300 grm. of dry soil.

M. Lefèvre † also records the results of his experiments upon plants grown in absence of CO_2. He finds that only those plants can be used, which are sufficiently vigorous and well-developed to adapt themselves to the crisis due to experimental conditions. Where seeds have only a small food-reserve the seedlings can only be used after previous cultivation in the open air, while plants with a large food-reserve can be experimented upon from the start of germination. Experiments show that green plants, when sufficiently strong, will grow for several weeks and even reach the flowering stage, if grown on an amide soil in absence of CO_2. The internal structure remains normal, but there is a slight diminution in chlorophyll and in secondary formations, and a marked increase in conjunctive parenchyma. That the amide compounds form the source of the plant's supply of carbon, is proved by the fact that control plants grown under similar conditions on ordinary soil, soon die. It is also proved that CO_2 in the soil is not utilised by green plants.

In his concluding paper, the author ‡ shows that the rapid increase in the dry weight of plants grown on an amide soil, without CO_2, is not the result of an osmotic upthrust of water, but is a real synthetic process; also that this synthesis is a chlorophyll function, impossible or much reduced in the absence of light. In summing up, he concludes that green plants have two sources of carbon (1) CO_2 of the atmosphere, (2) the carbon contained in the organic compounds of the soil; he also puts forward the hypothesis that chlorophyll has the power of synthesis, independent of the normal process of assimilation. Finally, he shows that the old idea of an impassable barrier between the nutrition of the animal and vegetable kingdoms, must give place to the experimental, biologic law, that organisms with chlorophyll, perform the work of synthesis, while those without it, perform the work of analysis.

* Rev. Génér. Bot., xviii. (1906) pp. 205–219 (1 fig.).
† Tom. cit., pp. 258–280 (4 figs.).
‡ Tom. cit., pp. 302–310.

Regeneration and Polarity in Higher Plants.*—H. Vöchting has investigated the cause of polarity in higher plants. Experiments on *Mercurialis annua* show that the seeds of plants grown on a klinostat produce seedlings which are indistinguishable from those arising from seeds grown under normal conditions. A second series of experiments was performed upon *Lopezia coronata*. Some of the plants were placed on the klinostat in a horizontal position, others in a vertical position, and a third set in a position midway between the horizontal and vertical. As before, the seedlings were normal. These seedlings were then grown on the klinostat, and cuttings were taken from them; some cuttings were planted in an upright position, while others were inverted. The former developed a few roots at their base, but the latter only produced a callus and soon died. The author concludes that polarity is not induced through the influence of any external force, but is a property of the plant tissues, which exists from the first, in the fabric of the idioplasm of the egg-cell.

Desert Shrubs and Atmospheric Moisture.†—V. M. Spalding has experimented with desert plants with the object of ascertaining if the leaves are capable of absorbing atmospheric moisture. The author finds that in *Fouquieria splendens* the leaves are incapable of absorbing water, but that a moist atmosphere tends to suppress transpiration, which is probably the reason for the retention of leaves in a moist atmosphere. Leafless shoots are able to absorb considerable quantities of water-vapour from a saturated atmosphere, but the rapidity with which they give it out again, even when the relative humidity is high, seems opposed to the view that much moisture is received from this source. Similar results were obtained with other types.

Physiology of Diatoms.‡—O. Richter describes the result of his experiments on the physiology of diatoms. Some years ago he discovered a method of ensuring pure cultures of these organisms, and he is therefore able to be sure of his facts. He finds that *Nitzschia palea* W. Sm. cannot live without silicic acid in the form of $CaSi_2O_5$ or $K_2Si_2O_5$. It is probable that calcium is also necessary, at least when SiO_2 is offered in the form of $K_2Si_2O_5$. *Navicula minuscula* has a still stronger need for chalk, while magnesium is another necessary ingredient in the food material of both species. Both are able to assimilate organic compounds of nitrogen, most easily asparagin and leucin, whereas in a free state nitrogen is useless to them. On the whole, diatoms need a weak alkaline reaction. The effect of other compounds is given, as well as the result of experiments in the degree of light and darkness most favourable to growth. The two species were found to be positively phototactic.

Irritability.

Galvanotropism of Roots.§—G. Gassner has investigated the effects of electric currents upon roots, and finds that (other conditions being

* Bot. Zeit., lxiv. (1906) pp. 101–48 (3 pls.).
† Bull. Torrey Bot. Club, xxxiii. (1906) pp. 367–75.
‡ SB. k. Akad. Wiss. Wien, cxv. (1906) p. 935 (6 pls.).
§ Bot. Zeit., lxiv. (1906) pp. 149–222 (11 figs.).

normal) the curvatures vary with the strength of the current. In every case the curvature varies with the species. A weak current acting for a prolonged period produces negative curvature; very strong ones, on the other hand, produce a positive curvature; while S-shaped curvatures are the result of prolonged, medium currents. The time of influence required to produce any given curvature varies inversely with the strength of the current. There is no definite distinction between the strength of currents required to produce positive and those required to produce negative curvatures, for by alteration of the time of influence the same current can produce either positive or negative curvatures. The positive and negative curvatures differ in nature, the positive being harmful in character, while the negative resembles that due to geotropic stimulus. The S-shaped curvature represents the transition from positive to negative. The author concludes that galvanotropism is a special case of traumatropism.

Effect of Light and Temperature upon Chlorophyll Assimilation.* W. Lubimenko has experimented with numerous shade-loving plants (ombrophiles), such as species of *Abies*, *Picea*, etc., and shade-avoiding (ombrophobe), such as *Pinus*, *Robinia*, etc., with the object of determining the effect of light and temperature upon photosynthesis. The author finds that under the conditions which obtain when chemical reaction is taking place in the interior of a living plant, light and heat generally act similarly upon the energy of CO_2 assimilation. For both these factors there are optima of intensity, above which assimilatory energy is weakened. The diminution of assimilation, after these optima are reached, is more strongly marked in ombrophiles than in ombrophobes.

Action of Light upon Transformation of Sugars.†—M. Lubimenko has also investigated the action of light upon the sugar absorption of *Pinus Pinea*, with the following results. In a weak light, the seedlings transform the sugar absorbed by them, into a compound analogous with saccharose. This transformation increases as the intensity of light becomes greater, but reaches its maximum in a very weak intensity, which is insufficient for the chlorophyll to decompose CO_2. In a stronger light, sugar assimilation decreases, but as the chlorophyll is now able to decompose CO_2, the dry weight of the plant is again increased; this last increase must be the result of reactions unconnected with sugar assimilation. These results seem to point to a new series of photochemical reactions, which take place in the plant-cell, independently of chlorophyll assimilation.

Rotation of Leaves of Marsilea.‡—R. F. Griggs records some observations on the diurnal rotation in leaves of *Marsilea vestita*. The rotation is remarkable, and is not due to movement or twisting of the common petiole, but rather of the petiolules of the leaflets.

* Comptes Rendus, cxliii. (1906) pp. 609–11.
† Tom. cit., pp. 516–19 (1 fig.).
‡ Ohio Naturalist, vi. (1906) pp. 554–5.

General.

Pedunculate Species of Trillium.*—H. A. Gleason has made a classification of the pedunculate species of *Trillium*. The three groups are characterised by their stigmas and ovary. In the group typified by *T. erectum*, each of the carpels is sharply bilobed and terminates in a thick, sessile, recurved stigma. In the second group, viz. that of *T. grandiflorum* type, the lobing is less distinct and the ovary is more rounded, while the stigmas are of uniform diameter throughout. In the last group, namely, those of *T. Catesbæi* type, the stigmas are slender and uniform in diameter, but they are united below to form a style.

The species are distinguished by the length of the stamens, colour of petals and ovary, and length and position of the peduncle.

Corolla in Relation to Insects.†—E. Giltay has investigated the attraction of the corollas of *Pelargonium* and of the corn-poppy for bees. Experiments tend to show that neither the scent nor the flower-form are important factors, although in particular cases either may have an attractive influence. The author agrees with those writers who regard colour as the chief source of attraction, but he also shows that the high development of the power of remembrance of places possessed by bees must be largely responsible for the systematic visitation of flowers. There is no proof that one bee brings another to flowers yielding honey, but the same flower-borders are constantly visited by the same bees. Different bees also show great differences in the intelligence displayed in flower-visitation.

Seed-dispersal in Polygonum virginianum.‡—H. S. Reed and I. Smoot show that *P. virginianum* is unique in that the requisite force for ejecting the ripe fruit is derived from tension in the pedicel. At a very early period a separation layer appears, which later on becomes cutinised and extends right across the pedicel. On the side of this layer nearer the achene is a cushion of pith-cells with thin, elastic walls, while the pith-cells remote from the achene have much thickened walls. The achene has a broad base of attachment, and its structure is of sufficient strength to resist fracture at all points except the separation layer. When, owing to external pressure, fracture occurs, the elastic pith-cells are released from the tension under which they are held, and shoot forth the achene with considerable force.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Ferns of the Philippine Islands.—H. Christ§ has received a second important collection of ferns made by A. Loher in the island of Luzon, coming partly from the centre of the island where Loher's first collection

* Bull. Torrey Bot. Club, xxxiii. (1906) pp. 387–96.
† Jahrb. Wiss. Bot., xliii. (1906) pp. 468–99 (3 figs.).
‡ Bull. Torrey Bot. Club, xxxiii. (1906) pp, 377–86 (7 figs.).
§ Bull. Herb. Boissier, vi. (1906) pp. 987–1011.

was obtained, and from the provinces of Rizal, Zambales, Laguna, and Union, the most interesting station being Mont. Banahao, on the summit (7500 ft.) of which occur some migrants of the Australian flora—*Lomaria Patersoni* and *L. Fraseri*. A surprising feature of the fern-flora of the Philippine Islands is that, despite the large number of the islands in the archipelago and the considerable size of some of them (Luzon, Mindanao, and Palawan), the species are so uniformly distributed throughout them —this applies even to the endemic species. The flora occurring on the mountain-tops of Luzon and Mindanao is almost identical; such a close resemblance is not found in the case of other Malayan islands, for instance, Java, Celebes, Borneo. The present enumeration consists of 103 species, including 22 new species and 3 sub-species. E. B. Copeland * publishes a second list of new Philippine ferns containing 25 species. Sixteen of these are new to science, and are described, and some of them figured.

Ferns of South China.—H. Christ † has received a second instalment of ferns collected by Père Cavalerie in Kouy-Tchéou in South China, and publishes their names, omitting most of the names which have already appeared in his previous paper and in his *Filices Bodinierianœ*. The present list containes 40 species, 10 of which are new to science. These Chinese collections, the author says, always contain striking novelties; and he calls attention to the explanation afforded by Leclère's paper ‡ on the geological configuration of inland China as to how this wealth of forms has been brought about on the elevated plateaux, isolated during a long geological period, whilst a slow and complicated development of primitive forms was taking place, the hot ravines having since been invaded by the Malay flora. The same author § publishes a list of 38 ferns, including 2 new species and 2 new varieties, collected by Père Esquirol at Kouy-Yang, the capital of the province of Kouy-Tchéou, and differing from the collections of Cavalerie and Boudinier in being less xerophilous and more of the shade-loving Malay type.

Ferns of Formosa.‖—J. Matsumura and B. Hayata publish an enumeration of the indigenous plants of Formosa, including a list of 249 ferns and 22 fern-allies. The local and external distribution, synonymy, and literature of the species, are given, and two new species described.

Hungarian Ferns.—I. Györffy ¶ complains of the omission of *Asplenium Ruta-muraria* from Simonkai's flora of Arad, and states that the variety *heterophyllum* of that species occurs in masses on the walls of a certain fortress. A. Degen ** calls attention to D. Hirc's record of *Hymenophyllum tunbridgense* in Croatia.

* Philippine Journ. of Sci. Manila, i. (1906) pp. 251–62 (4 pls.).
† Bull. Acad. Internat. Géogr. Bot., xv. (1906) pp. 233–46 (figs.).
‡ Bull. Soc. Agric. Sci. et Arts de la Sarthe, lx., p. 49.
§ Bull. Acad. Internat. Géogr. Bot., xv. (1906) pp. 247–52.
‖ Journ. Coll. Sci. Imp. Univ. Tokyo, xxii. (1906) pp. 552–641.
¶ Magyar Bot. Lapok., v. (1906) p. 303.
** Tom. cit., p. 310.

North American Ferns. — D. W. Fellows * gives an account of the fern-flora of Maine. Though the whole of the state has not been explored, it yields 38 species and 10 varieties of ferns, and 27 species and 6 varieties of fern-allies. B. D. Gilbert † describes a new and peculiar variety of *Polypodium vulgare* from Pennsylvania. W. N. Clute ‡ gives a brief account of the genus *Oleander*, and figures one of the species. H. H. Negley § gives field-notes upon some 14 rare species of ferns and the conditions under which they grow in a remote part of Florida. T. C. Palmer ‖ records the reappearance of the rare fern *Asplenium ebenoides* in Chester Valley, Pa., near its original station. It is associated with *A. platyneuron* and *Camptosorus*, to the former of which it shows some external resemblance. R. J. Smith ¶ somewhat enlarges the narrow distribution of *Selaginella Bigelowii* in South California. J. H. Ferriss ** has been trying to cultivate in Joliet Park, Ill., all the North American ferns. He relates his vicissitudes. Some of the species grew like weeds; others died off at once or in a few months. The Canadian species are as difficult to grow as those brought from rock or desert. For some of them suitable nooks have been found by experiment. The writer has travelled in the South Western States collecting specimens and noting their habitats, but says that much more of such local knowledge is requisite. W. N. Clute †† figures and describes a curious new form of *Osmunda regalis* with overlapping orbicular pinnules. It grows in Vermont. W. A. Squires ‡‡ records a new station, in Northern Idaho, for the rare *Selaginella Douglasii*. Previously it was known only between Northern California and British Columbia. Mrs. J. J. Puffer §§ describes successful attempt to transplant *Woodsia ilvensis* from the arid exposed rocks on Mount Tom, Mass., to a stone wall in her garden, in which position it now grows luxuriantly. W. N. Clute ‖‖ continues his check-list of North American fernworts, enumerating 22 species, with their varieties. P. Dowell ¶¶ describes some habitats of *Dryopteris Boottii* Underw. in the eastern United States—in Staten Island, New York, and New Jersey. This fern appears to be suited by the same swampy conditions which are favourable to the growth of *D. cristata*, *D. Clintoni*, *D. spinulosa* and its subspecies *intermedia*. The author's observations do not enable him either to prove or to disprove whether *D. Boottii* is a hybrid; he points out a few characters which distinguish it from both its proposed parents. Until it has been raised by artificial crossing from these latter, we are not justified in pronouncing it to be a hybrid. The same author *** gives a list of 31 pteridophytes from Staten Island, together with their distribution.

Botrychium in South America. †††—H. Christ discusses the South American species of *Botrychium*, and describes *B. Negeri*, a new species

* Fern Bulletin, xiv. (1906) pp. 97–104.
† Tom. cit., p. 105.
‡ Tom. cit., p. 106.
§ Tom. cit., pp. 107–110.
‖ Tom. cit., p. 111.
¶ Tom. cit., p. 111.
** Tom. cit., pp. 112–114.
†† Tom. cit., pp. 115–16.
‡‡ Tom. cit., p. 116.
§§ Tom. cit., p. 117.
‖‖ Tom. cit., pp. 118–21.
¶¶ Torreya, vi. (1906) pp. 205–9.
*** Proc. Staten Island Assoc. Arts and Sci., i. (1906) pp. 61–7.
††† Arkiv f. Botanik, vi. No. 3 (1906) 6 pp. (figs.).

from Chile belonging to the *B. ternatum* group, and also *B. Lunaria* var. *Dusenii*, a new variety from Patagonia. With this variety occurs *B. ramosum* Aschers., which had been regarded by Prantl as the Patagonian form of *B. Lunaria*.

Development of Pteridium.*—T. Lagerberg, having noticed the rapid development of the gametophyte of *Pteridium aquilinum* from the sown spore, has made a special study of the sexual generation of this species, a subject which had been somewhat neglected. He describes the spores, their structure and germination; the gametophyte in its various stages, its monoecism; the spermogonia, spermatozoids; the absence of apogamy; the typical character of the archegonium; Farlow's discovery of apospory; the sporophyte; the stages of development exhibited by the annual leaf as the plant passes from infancy to maturity.

Morphology of Dennstaedtia.†—H. S. Conard describes the morphology of the fern stem as illustrated by *Dennstaedtia punctilobula*. The young sporophyte has a protostele up to the first fork, and above has a tubular stele with internal and external phloem, and a sclerotic pith. In the root the endodermis belongs to the cortex, in the stem it belongs to the central cylinder.

Lepidodendron aculeatum.‡—A. C. Seward describes the anatomy of a fossil specimen preserved in the Cambridge Botany School. On its external characters, the form of the leaf cushions, it is referred to *Lepidodendron aculeatum* Sternb. The record of its original locality is lost. The structure agrees closely with that of *Lepidophloios fuliginosus*, save that in the latter the leaf-traces run a horizontal, and not a steeply ascending, course through the middle cortex. The author prefers not to attempt to separate the two genera on purely anatomical evidence.

Tubicaulis, a British Fossil Fern.§—M. C. Stopes describes a new fern from the coal measures, *Tubicaulis Sutcliffii*. The only other known species of the genus was found in the Permian in Germany. The new specimen appears to have been the upper part of a herbaceous fern. The form and structure of the specimen are described.

DAMAZIO, L.—**Une nouvelle fougère du Brésil.** (A new Brazilian fern.)
[*Oleandra Bætæ.*] *Bull. Herb. Boiss.*, vi. (1906) p. 892.

GORTANI, L. & M.—**Flora Friulana.** (Flora of Friuli.)
[Treats more particularly of the Carnic Alps, and contains a list of 28 ferns and 17 fern allies.] Udine: Doretti, 1906, parte 2, pp. 43–51.

REGNY, V. DE, E M. GORTANI—**Fossili carboniferi del M. Pizzul e del Piano di Lanza nelle Alpi Carniche.** (Fossils of the Coal-Measures of M. Pizzul and of Piano di Lanza in the Carnic Alps.)
[Treats of the rich fossil flora, 54 p.c. of which are ferns and 20 p.c. are Lycopodineæ, in relation to the age of the geological strata in which they are found.] *Boll. Soc. Geol. Ital.*, xxiv. (1905) pp. 461–605 (4 pl.).

* Arkiv f. Botanik, vi, No. 5 (1906) 28 pp. (5 pls.).
† Johns Hopkins Univ. Circular, May 1906. See also Bot. Centralbl., cii. (1906) p. 545.
‡ Ann. of Bot., xx. (1906) pp. 371–81 (1 pl. and figs.).
§ Mem. Proc. Manchester Lit. Phil. Soc., l. iii. No. 10 (1906) 2 pls. and figs.

Bryophyta.

(By A. Gepp.)

Chinese Muscineæ.—E. Levier * publishes an alphabetical enumeration of the Muscineæ collected by the Italian missionary, G. Giraldi, in the province of Shen-si, China. The lists comprise 286 mosses and 69 hepatics. The mosses were examined by C. Mueller,† who determined 265 mosses, 228 of which were new species. The mosses have been revised by V. F. Brotherus, who has described 7 more new species and reduced 28 of those described by C. Mueller, and raised the total of the determinations to 286. The hepatics were originally described and figured by C. Massalongo,‡ and have since been revised by F. Stephani. Massalongo has described 19 new species and 11 new varieties; Stephani has added 8 new species. In his introduction Levier gives a brief notice of Giraldi, and considers the general character of the Shen-si moss-flora. It is principally of the type found in the north temperate zone. The 69 species which are not endemic are mostly (52) to be found in Europe, Asia, and the United States; only a few occur in the Chinese littoral region, Japan, Corea, and Formosa. Two are very remarkable—*Papillaria nigrescens* and *Orthostichopsis tetragona*—being tropical American species. *Giraldiella* and *Ascidiota* are new genera of mosses and hepatics invented by C. Mueller and C. Massalongo respectively.

North American Muscineæ.—I. Hagen,§ having obtained some fine specimens of *Tetraplodon australis* from Florida, collected in December, has been able to study the species thoroughly and demonstrate that it differs from *Tetraplodon* in having a soft hyaline seta, exserted columella, geminate teeth, and a short conical calyptra. In these points it agrees with *Splachnum*, and particularly with *S. ampullaceum* and *S. vasculosum* in the structure of the costa and the false leaf-traces in the stem. The author sets forth the synonymy of the plant, and revives the name *S. caulescens* Dicks. J. W. Bailey ‖ publishes some field-notes on the mosses of Vancouver Island, founded on collections made at Cumberland, on the east side of the island. A. Lorenz ¶ publishes some notes on the mosses of Waterville, New Hampshire, a granite region. The interesting features of the moss-flora in relation to the environment are brought out. C. C. Haynes** figures and gives some critical notes on three species of the genus *Lophozia*. J. F. Collins †† finds that *Polytrichum commune* is far less common than has been generally supposed, and is very variable in its characters. He gives a definition of what he takes to be the true plant, and asks collectors to examine carefully specimens from all sorts of localities. He treats of the varieties *perigoniale* and *uliginosum*, and states that after examining thousands of leaf sections of *P. commune* and its allies, he has become aware that there is much more variation in the lamellæ than is admitted

* Nuov. Giorn. Bot. Ital., xiii. (1906) pp. 237–80, 347–56.
† Op. cit., 1896–8.
‡ Atti Accad. di Verona, 1897.
§ Bryologist, ix. (1906) pp. 92–4.
‖ Tom. cit., pp. 95–6.
¶ Tom. cit., pp. 96–97.
** Tom. cit., pp. 99–100 (figs.).
†† Rhodora, viii. (1906) pp. 131–5. See also Bryologist, ix. (1906) pp. 101–2.

in the standard descriptions. The end-cell of the lamella varies in form in the same leaf according to its height above the base of the leaf; the lamellæ also vary according to the age of the leaf and the degree of soil moisture, and in fact depend upon the environment. The author adds notes on other Polytrichaceæ.

German Mosses.—H. Brockhausen * treats of the geographical and ecological distribution of *Tetraplodon mnioides* in Germany. His observations of the plant were made in Northern Westphalia, where it grows in damp places among heather, in sunny pine-woods, on dry sandy roads: it prefers to grow on old bones and teeth of hares, rabbits, and mice, and rarely on dogs' excrement; and it avoids chalk. It is perennial and fruits very freely between April and September. It is a lowland and not a highland species. V. Schiffner† gives a list of the more interesting species in a collection of Muscineæ made by V. Patzelt in the neighbourhood of Reichenhall in Bavaria. Three hundred species were collected at altitudes of 1500–2000 ft.; among them are several subalpine plants which have descended unusually low.

Moss-flora of the Harz.‡—H. Zschacke publishes a second contribution to the moss-flora of the Duchy of Anhalt, treating specially of the north-east Harz mountains, a district well known through Loeske's *Harz Flora*. The author gives word-pictures of a dozen stations between the altitudes of 1000 and 1900 ft., in which he describes their moss-clothing and thus affords some interesting comparisons. Equally interesting are the four tables enumerating the mosses which find in this region their north, south, east and west limits respectively.

Swiss Mosses.§—R. Keller publishes a third contribution to a knowledge of the moss-flora of Canton Unterwalden. He gives a list of 152 species collected in the neighbourhood of Stanzstaad, Kerns, and Melchthal, determined by J. Weber.

Old Bohemian Moss-records.‖—F. Matouschek has been examining the mosses in the Landes Museum at Prag, and publishes a revision of the older records, made by the native botanists between 1817 and 1860, taking special note of the determinations of Opiz, which he converts into modern terminology.

Hungarian Mosses.—M. Péterfi ¶ publishes some contributions to the Sphagnum-flora of Hungary, founded on material preserved in various public and private herbaria. He calls special attention to the high moorland of Bory in Arva which is the richest station in Hungary for Sphagnaceæ; and one of the commonest species occurring there is *S. molluscum*. Two species and nine varieties are new to the flora. A long critical note is appended to *S. subtile* Warnst., a species intermediate between *S. rubellum* and *S. acutifolium*. I. Györffy** records the sporadic

* Allgem. Bot. Zeitschr., xii. (1906) pp. 161–2.
† Tom. cit., pp. 173–6.
‡ Verh. Bot. Verein. Prov. Brandenburg, xlvii. (1905) pp. 223–316.
§ Bull. Herb. Boissier, vi. (1906) pp. 893–900.
‖ Mitt. Ver. Naturfr. Reichenberg, xxxvii. (1906) pp. 1–22.
¶ Magyar Bot. Lapok., v. (1906) pp. 260–7. ** Tom. cit., pp. 285–6.

occurrence of *Amphidium lapponicum* Schimp. in the Hohe Tatra, where it forms small patches in rifts in the granite irrigated by icy-cold water. M. Peterfi * describes *Bryum Hazslinszkyanum*, a new species of the section *Ptychostomum* and closely allied to *B. pendulum*. It occurs on the walls of the basilica at Esztergom. I. Györffy † records the occurrence of the rare moss *Molendoa Hornschuchiana* Lindb. at five stations in the Hohe Tatra, on moist shady rocks. He has discovered *Neckera complanata* var. *longifolia* and *Catharinæa undulata* var. *polycarpa*, which are also additions to the Hungarian flora.

Mosses of Central Asia.‡—V. F. Brotherus gives an account of the mosses collected by Lieut. Olufsen during his second expedition to the Pamir. Twenty-six species and four varieties are recorded, coming mostly from the Pamir (13,000–14,000 ft.), and the Altai Mountains (9000–10,000 ft.). Three species are new to science. The species of *Bryum* were determined by the late Professor Philibert, and are described by Brotherus. Only four pleurocarpi occur in the list.

Tropical Mosses.§—E. G. Paris gives a short list of seven mosses and two hepatics from the high frontier plateau between French Somaliland and Abyssinia. One species is new. He also gives a list of 55 mosses and 19 hepatics collected by Frère Apollinaire in the Columbian Andes. Three mosses and one hepatic are new species.

South American Mosses.‖—P. Dusén publishes a fourth instalment of his contributions to the bryology of Magellan, West Patagonia, and South Chile. He describes 25 new species, and adds critical notes on species previously known.

Musci Europæi exsiccati.¶—E. Bauer publishes a series of critical notes on his *Musci Europæi exsiccati*, series iii.–v., containing descriptions of new species, additional notes on some of the specimens in the two previous series, and very detailed keys to the European species of *Campylopus*, *Dicranodontium*, *Metzleria*, and *Didymodon*.

Classification of the Harpidia.**—F. Renauld describes the principles which he has adopted in classifying the *Harpidia* :—(1) to admit as specific types only well defined and fixed species; (2) to regard as subspecies certain widely distributed derivatives from the types less clearly defined and usually, but not absolutely, fixed in their characters; (3) to recognise certain groups of varieties or forms which interrelated cluster round the species and subspecies; (4) to distinguish among these groups a certain number of well-marked varieties, especially those which tend to become generalised through adaptability to their environment. The author then enters into details, and offers a series of critical remarks upon the various species and forms, and their relationships, etc.

* Magyar Bot. Lapok., v. (1906) pp. 286–94 (1 pl.). † Tom. cit., pp. 302–4.
‡ Bot. Tidsskrift, xxvii. (1906) pp. 203–8.
§ Rev. Bryolog., xxxiii. (1906) pp. 101–5.
‖ Arkiv f. Botanik, vi. No. 8 (1906) 40 pp., 5 pls. and figs.
¶ SB. Deutsch. Nat. Med. Ver. "Lotos," Prag, xxvi. (1906) pp. 111–48.
** Rev. Bryolog., xxxiii. (1906) pp. 89–100.

Change of Habitat by a Saxicolous Moss.*—G. Dismier announces the finding of a fruiting specimen of *Rhynchostegium tenellum* growing on a tree-trunk, though the species is otherwise known to occur on calcareous rocks only. The specimen is quite distinct from the arboricolous *R. litoreum*. The author also found in the Vosges tufts of the arboricolous *Orthotrichum obtusifolium* growing on walls.

Monograph of Lophocolea.†—F. Stephani continues his monograph of the genus *Lophocolea*, supplying new descriptions of 96 species, 49 of which are new to science.

Riccia Bischoffii.‡—H. Witte has discovered this hepatic on a chalky heath near Borgholm, Öland, Sweden. It is a mid-European species, not previously known north of the Harz mountains. Its northern limit is thus moved five degrees to the north.

Epigonium of Mosses.§—H. A. Rosander has studied the development of the calyptra, vaginula, and sporogonium of the mosses. He employs the word epigonium to represent the organ that covers the young sporogonium — an organ of varying origin, but separating eventually into calyptra and vaginula. He regards the development of this epigonium as of great systematic value, and he gives a key under which the various moss-families are ranged from this point of view. The author's views, however, are by no means approved of by Arnell, who supplies a précis of this paper in the "Centralblatt."

Sexual Polarity of Spores in Dioicous Mosses.‖—El. and Em. Marchal publish some experimental researches on the sexuality of the spores in dioicous mosses. By pure cultures of the spores of *Barbula unguiculata*, *Bryum argenteum*, and *Ceratodon purpureus*, the authors have found that the spores in a capsule are heterogeneous; some are male and transmit this sexuality through the protonema to all its offshoot moss-plants; the others are female and produce only female plants. This sexual polarity is faithfully transmitted by the moss-plants to all their vegetative offshoots. The environment is incapable of modifying the sexual polarity of the protonema and its offshoots.

Abnormal State of Atrichum.¶—Potier de la Varde gives a description and figure of an anomalous state of *Atrichum undulatum* found growing on very arid talus near Guingamp (Côtes du Nord). The plant is much dwarfed, and its pedicel is ensheathed to three-quarters of its length by an involucral bract, which is tubular below, split above, possessing neither nerve nor margin, but bearing on its back some spines analogous to those on an ordinary leaf. Its function can hardly be to protect the young sporogonium in its arid situation, for quite normal plants grow alongside. The production of this structure

* Rev. Bryolog., xxxiii. (1906) pp. 105–6.
† Bull. Herb. Boissier, vi. (1906) pp. 872–88, 935–66.
‡ Bot. Notiser, 1906, pp. 211–14.
§ Disputation Upsala, 1906, pp. viii. and 100, 113 figs. See also Bot. Centralbl., cii. (1906) p. 540.
‖ Mém. Couronn. publ. par Class. Sci. Acad. Roy. Belg., sér. 2, i. (1906).
¶ Bull. Acad. Internat. Géogr. Bot., xv. (1906) pp. 287–8 (figs.).

appears to weaken the growth of the plant, this latter being much dwarfed and bearing a shortened truncate capsule with an operculum, not rostrate but obtuse, with a few apical papillæ.

Nematode-Galls.*—E. Marchal records an instance of deformation caused by nematodes in the stems of a pot-cultivated specimen of *Lophocolea bidentata*.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

British Algæ.†—A. P. Bradshaw publishes some short notes on the study of the British Algæ, with the intention of helping amateurs who know nothing of the subject and wish to have some general information. He defines shortly the three main groups, deals with their zonal distribution and describes the structure of certain algæ in general terms. A short account of the reproduction of *Ectocarpus siliculosus* is given, and other points of structure and habit are treated in a popular style.

Algæ formations of the Faeroes.‡—F. Börgesen occupies the sixth number of series 4 of Vegetationsbilder with six very good photographs of marine algæ taken in the Faeroes. They represent two species of *Fucus* on steep rock faces, several species of red algæ in the same situation, plants of *Himanthalia lorea* and some red algæ fringing the edge of rocks, a bed of *Laminaria digitata* and *Alaria esculenta* at dead low tide, and a mass of *Fucus vesiculosus* and *Ascophyllum nodosum* clothing the side of a rock. The plates of *Himanthalia* and other brown algæ are remarkably clear and good. A preface to the plates deals with the conditions of algal life at the Faeroes, such as temperature, salinity, ebb and flow of the tide, strength of the waves, temperature of the air, etc. In general the conditions are such as to promote a luxuriant growth of algæ down to a depth of 40 metres.

Swedish Algæ.§—H. Kylin records the occurrence of *Polysiphonia fastigiata* on the west coast of Sweden, where it was previously unknown. It was growing on *Ascophyllum nodosum*; and itself bore the following epiphytes :—*Choreocolax Polysiphoniæ*, *Myrionema Corunnæ*(?), *Isthmoplea sphærophora*, *Ulothrix flacca*, and *Monostroma Grevillei* (?).

Algæ of the Mediterranean.‖—F. Ardissone completes his revision of the Mediterranean algæ in the present paper, which contains a list of the Melanophyceæ, Chlorophyceæ, and Cyanophyceæ. Besides alterations in the disposition of the families, the present revision shows not a few changes in the arrangement and limitations of certain genera, notably in Ectocarpaceæ and Oscillariaceæ.

* Rev. Bryolog., xxxiii. (1906) p. 106.
† Annual Report and Trans. Manchester Microscop. Soc., 1905 (issued 1906) pp. 56–60.
‡ Vegetationsbilder. Edited by Karsten and Schenk, series 4, No. 6, 1906.
§ Bot. Notiser, 1906, pp. 245–7.
‖ Rend. R. Ist. Lombardo, series 2, xxxix. (1906) pp. 156–76.

Algæ of the West Indies, Indian and Pacific Oceans.*—N. Svedelius deals with the interesting subject of the likeness between the marine flora of the West Indies, the East Indies, and the Pacific. He disapproves of the theory that the Cape of Good Hope had formerly a more tropical climate and served as a passageway for algæ. From a careful study of *Caulerpa* and other genera in the Indian Ocean he is led to the belief that the Caribbean Sea was at one time in connection with the Pacific Ocean and was only separated at a later date by the upheaval of land at the isthmus of Panama.

Algæ of a Ceylon Coral Reef.†—N. Svedelius has made a careful study of the algæ on the large coral reef which surrounds the town at Point de Galle, Ceylon. His object was to discover if in the tropics there is any periodicity of marine algæ, and his investigations have led him to the following interesting and important results. He finds that a rich, purely littoral flora may occur in the tropics, a fact which has been somewhat doubted hitherto. Certain conditions are of course necessary, such as for instance an absence of predominating living coral, as this prevents the growth of algæ other than those with a strong creeping rhizome. Further, he finds that the Florideæ are more numerous both as regards species and number of individuals than the other algæ-groups, notwithstanding the strong light. The littoral Florideæ have not pure red chromophyll, but rather a dark violet, grey-brown, and grey-green tone of colour. As regards periodicity in the algæ he finds this quite a marked feature: certain short-lived species such as *Porphyra suborbiculata* and *Dermonema dichotomum*, only occur during a particular part of the year; other species are perennial, arising either from a basal disc or from basal holdfasts, which persist, while the upper part of the thallus bears new shoots season by season:—examples being *Laurencia ceylanica*, *Rhodomela crassicaulis*, *Sargassum cristæfolium*, and *Avrainvillea lacerata*. Again certain species show their periodicity by becoming fertile at special seasons of the year. In many instances periodicity is connected with the change of monsoon, some species appearing only after the south-west monsoon has been blowing for some time, while others choose this time for dropping and regrowing their shoots. In what way the monsoon influences the plants is not known at present, though several theories are put forward. Finally the author states that short-lived species are very few, while the great mass of species are perennial and bear during the whole year the most intense sunlight. Two photographs show a formation of *Rhodomela crassicaulis* and *Corallopsis Opuntia* respectively.

Vegetation of the Antarctic Sea.‡—C. Skottsberg, the official botanist to the Swedish Antarctic Expedition, has published his observations on the marine flora of this region. The main bulk of his collections were unfortunately lost with the ship, but sufficient were saved to enable the author to give a fuller account of the conditions affecting the algæ, and the species growing or collected there, than

* Bot. Notiser., 1906, pp. 49-57.
† Botaniska Studier. Tillägnade: F. R. Kjellman, 1906, pp. 184–220 (1 pl.).
‡ Tom. cit., pp. 245–64 (3 pls. and 1 map).

any paper hitherto published. After an introduction giving a short *résumé* of past work, the author deals with "The influence of external factors," such as the geological character and configuration of the coast; the bottom, the salinity, and temperature of the sea; and the influence of the ice. Tables help to show these results. A section on "The regional distribution of the marine flora" divides the area into the three Kjellman regions—the littoral, the sublittoral, and the elittoral. The species occurring in each of these are discussed, and an explanation is given of the presence of certain algæ brought up by the dredge from considerable depths. They are brought by the icefloes which run against the coast, and become packed and screwed together in many ways. Algæ attach themselves to the lower parts of these floes, and, when the pack ice disperses, the waves wash the floes, and the algæ become detached and sink to the bottom. It is, of course, impossible to say how far this factor influences the distribution of the species, but it is at least probable that it plays some part. A few remarks are made on the characteristic formations. Then follow a list of the dredging stations and a list of Antarctic algæ, not including the undetermined part of the author's own collection, nor the collection of the 'Discovery,' with a few general remarks. Photographs are given of *Desmarestia Harveyana*, *D. anceps*, and *Gracilaria simplex*; as well as a map of Graham Land.

Periodicity of Algæ in Toulouse.*—J. Comère has made observations on the periodicity of development of the algæ in the Toulouse region. He comes to the following conclusions. The general distribution of fresh-water algæ is determined by the mechanical action of the various temporary and permanent media, while the periodicity of development is governed by the thermic influence of the various seasons of the year. Running water is unfavourable to the growth of green algæ, owing to mechanical action and the poverty of the water in saline substances; more quiet streams of which the water is often disturbed is no less unfavourable. Stagnant water shows an infinitely richer algal flora. Under mixed conditions, where the water is constantly renewed, he finds potamophilous diatoms, together with limnophilous Chlorophyceæ and Protococcoideæ, having a periodicity of evolution similar to that of the same species living in rapid and in stagnant water. The algæ produce a relatively large number of spores, etc., immediately before threatened evaporation.

Tropical Fresh-water Algæ.†—E. Lemmermann describes a collection of fresh-water algæ, consisting of fifteen samples, collected by Dr. Volz in Sumatra, West Java, Singapore, Bangkok, and the Sandwich Islands. Of these regions the best known is West Java. Fifty-one novelties are described, and interesting statements are made concerning the Flagellatæ and Peridineæ, and the composition of the plankton of two lakes. The author prefaces his list by some remarks on the similarity between the fresh-water algæ of European and tropical

* Bull. Soc. Bot. de France, 1906, pp. 390–407.
† Abh. Nat. Ver. Bremen, xviii. (1905) pp. 143–74.

waters. He believes that further investigation will show a still greater number of species common to both regions.

Fresh-water Algæ of Sweden.—O. Borge* publishes a list of the fresh-water algæ of Sweden. It includes 44 species new to Sweden, and nine species and varieties new to science.

The same author † publishes also a list of algæ from Argentina and Bolivia, collected by R. Fries and G. O. Malme, which contains no novelties. There are a few text figures.

Fresh-water Algæ of Victoria.‡—A. D. Hardy brings the fresh-water algal flora of Victoria up to date, omitting the Bacillarieæ; and he publishes four new species, as well as some new records for Victoria. A number of Desmids are included supplementary to the list of 156 species and varieties already enumerated in the author's previous account of the Victorian Desmidiaceæ. The novelties are described by G. S. West, including a new zygospore for *Pleurotænium ovatum* Nordst. var. *tumidum* Mask. Finally, a short list is given of new localities for eighteen species of Desmids already recorded from Victoria.

Desmideæ of Central Europe.§—W. Migula continues his account of the cryptogams in Thomé's "Flora von Deutschland," being at present engaged in the exposition of the Desmideæ. He supplies descriptions of the genera and species ranged between *Closterium* and *Arthrodesmus*, the space in four parts of the work being chiefly occupied by *Cosmarium* with more than 200 species. To these, as to the species of other genera, a dichotomous key is provided, and there are numerous figures.

Fossil Diatoms.‖—P. Maury having completed his investigations into the pliocene vegetation of the volcanic region of Cantal, has made researches in the valley of the Veronne, and finds at La Garde a rich stratum of Diatomaceæ. These have been examined by Frère Héribaud who points out the identity of this flora with the diatomaceous floras of Joursac, Moissac and other localities of the Cantal region already studied by him. He describes besides seven new species but gives no figures.

Spores of Diatoms.¶—H. Peragallo redescribes in detail the formation of spores in diatoms: the formation of sporangia, development of the spores which become smaller and smaller by subdivision into two, their progressive stages, transformation into zoospores within the mother cell, and finally the dehiscence of the sporangium and the escape of the zoospores.

Dunaliella.**—E. C. Teodoresco publishes further observations on the morphology and biology of this genus, thereby completing his study of its development. His remarks are arranged under the following headings:—Changes in external form; Internal structure: Cell division;

* Arkiv f. Botanik, vi. No. 1 (1906) pp. 1–98 (3 pls.).
† Op. cit., No. 4 (1906) pp. 1–13 (figs. in text).
‡ Victorian Naturalist, xxiii. (1906) pp. 18–22, 33–42.
§ Gera: Zezschwitz, 1906, lief, 31–4, pp. 385–512 (20 pls.).
‖ Revue de la Haute-Auvergne, 1906, 49 pp.
¶ Soc. Sci. d'Arcachon Stat. Biol., viii. (1904–5, appeared in 1906) pp. 127–44.
** Rev. Gén. de Bot., xviii. (1906) pp. 353–71.

Sexual reproduction ; Resting state ; Germination of the hypnozygotes. Details are given of experiments to show that under certain unfavourable conditions the zygotes undergo a period of repose. This fact was not previously known. This is the first instalment of the paper which will be continued in a later number.

Colpomenia sinuosa.*—Fabre-Domergue gives an account of the remarkable invasion of the oyster beds at the mouth of the Vannes by *Colpomenia sinuosa*. It appeared for the first time last year in the Gulf of Morbihan, its nearest locality being Cadiz. Its presence at Vannes is seriously prejudicial to the interests of the oyster growers, for the plant settles on the shell of the oyster, and when the tide goes down it becomes emptied of its contents and filled with air. Adhering so firmly as these plants do to the oysters they act as floats when the tides are high ; and the oyster comes to the surface and is carried away. The result threatens to be a serious injury to the oyster trade.

Acrochætium and Chantransia.†—F. S. Collins arranges the North American marine species of these two genera according to the principles of Mons. Bornet's paper, with descriptions of each species. The paper in question was published a short time ago in the "Bull. Soc. Bot. de France," and contained full descriptions of only two species, though copious references are made to herbarium specimens in exsiccatæ, etc. F. S. Collins' paper, therefore, is, as it were, a continuation of Mons. Bornet's work. Only twelve species have been recorded as yet from North America including the West Indies, and these are here fully described, and keys are given. The classification is based largely on the characters at the base of the filament, whether it arises from a single cell, or from a cellular disc, or from horizontal branches, attached to the host. Two new species are described—*Acrochætium Dasyæ* and *A. Dictyotæ*. Keys to the two genera are given.

ARTARI, A.—**Der Einfluss der Konzentration der Nährlösungen auf die Entwickelung einiger grüner Algen.** (The effect of concentration of nutritive solutions on the development of certain green algæ.)
[The species in question were *Stichococcus bacillaris*, gonidia of *Xanthoria parietina*, and *Chlorella communis*, a new species resembling *C. vulgaris*.]
Jahrb. f. Wiss. Botan., xliii. (1906) pp. 177–214.

EWART, A. J.—**Notes on a Collection of Marine Algæ from King Island.**
[A list of 32 species from King Island, Bass Strait, collected by Mrs. Spong and named by Mr. A. H. S. Lucas. There are no novelties.]
Victorian Naturalist, xxiii. (1906) pp. 90–1.

GAIDUKOV, N.—**Die komplementäre chromatische Adaptation bei Porphyra und Phormidium.** (Complementary adaptation in *Porphyra* and *Phormidium*.)
[The results of spectroscopic experiments on these two algæ.]
Ber. Deutsch. Bot. Gesell., xxvii. (1906) 1 p.

HABERLANDT, G.—**Ueber den Geotropismus von Caulerpa prolifera.** (On the geotropism of *C. prolifera*.) *SB. k. Akad. Wiss. Wien*, cxv. (1906) pp. 577–89.

* Comptes Rendus, cxliii. (1906) pp. 1223–5.
† Rhodora, viii. (1906) pp. 189–96.

Fungi.

(By A. Lorrain Smith, F.L.S.)

Culture Medium for Zygospores.*—J. J. Hamaker claims to have discovered a culture medium on which, with proper conditions of moisture and temperature, a successful growth of the zygospores of *Mucor stolonifer* can be induced.

New Ascomycetes.†—W. Kirchstein describes fifty-three new species from the Mark Brandenburg. There are several new genera recorded: *Hyphodiscus* near to *Tapesia* and to *Trichobelonium* but with globose spores; *Ophiosphæria* with elongate one-celled spores near to *Niesslia*; *Pachyspora* belonging to the Trichosphæriaceæ, the asci two-spored, the spores two-celled, dark brown. *Bertiella* a genus of Melanommeæ with a polysporous ascus and two-celled colourless spores, must be called *Kirchsteinia* as the name *Bertiella* has already been used; the fungus recalls the appearance of *Bertia*. Finally, he describes *Trematosphærella*, distinguished from *Trematosphæria* by the perithecium and the absence of paraphyses.

Study of the Grey Rot of the Vine.‡—Gy. de Istvanffi has made an exhaustive study of this disease, found to be due to *Botrytis cinerea* (*Sclerotinia Fuckeliana*). The first part of the work is taken up with microbiological studies: the germination of the spores and their behaviour in various culture solutions, their resistance to drying and to cold, etc. The author also tested the spores and their capacity to germinate after soaking them in Bordeaux mixture, in glycerin, and organic salts. The results of all these experimental researches are given. The sclerotium is also studied and the development of the clamp organs—*Haftorganen*. He describes two types of these: the first are hollow bodies and die off; the second develop further and form zones of hyphal tissue of darker and lighter colour. The sclerotia are formed from these larger clamp organs. They take several months to ripen, and germinate under suitable conditions with conidiophores of *Botrytis*.

Diseases of Plants due to Sclerotinia.—Emil Molz§ writes on the conditions affecting the appearance of *Sclerotinia fructigena* on apples. The conditions, studied by him and tested by a long series of experiments, which are presented in tabular form, had reference chiefly to light, temperature, and moisture. He found generally that darkness and a low temperature hindered the growth of the fungus. In the case of stored fruit a slight current of air would scatter the spores from a diseased apple and infect a large number of sound fruits. A careful watch would remedy this, as the apples attacked show rottenness very soon and should be removed at once. Too great moisture was also proved to be a powerful agent in encouraging the growth of *Sclerotinia*.

* Science, II. xxiii. (1906) p. 710. See also Bot. Centralbl., cii. (1906) p. 583.

† Abh. Bot. Ver. Prov. Brandenburg, xlviii. (1906) pp. 39–61 (5 figs). See also Ann. Mycol., v. (1906) p. 455.

‡ Ann. Inst. Centr. Ampélol. R. Hongrois, iii. (1905) p. 183 (8 pls. and 15 figs.). See also Centralbl. Bakt., xvii. (1906) pp 280–9.

§ Centralbl. Bakt., xvi. (1906) pp. 175–8 (4 figs.).

In the same Journal H. C. Schellenberg * publishes a paper on the *Sclerotinia* of the mulberry and of the beam tree. He found the mummified fruits of the mulberry in the early part of the year, and proved that they differed morphologically from the *Sclerotinia* that is found on the quince. He cultivated the sclerotia, and towards the end of April he obtained the apothecia which he describes in full detail. Infection experiments were carried out with the ascospores, and it was found that the young shoots of the mulberry were the parts that were first attacked by the fungus and later the leaves. Very soon the conidial growth appeared. In the moist spring of 1905, the trees were badly attacked and nearly all the young fruits were infected. If the flower is infected before fertilisation it withers off, if after fertilisation, the fungus develops with the fruit, which it gradually mummifies. *Sclerotinia Mespili* is compared with *Scl. Cydoniae* on the quince, and the differences noted in development and mode of growth.

The similar fungus of the beam tree, *Sclerotinia Ariae*, is next described. It was found to be distinct from *Scl. Aucupariæ* and would not infect *Sorbus Aucuparia*. In this case also the flower is attacked. The spores germinate on the stigma and pass through the style to the young fruit, which soon becomes a hard mummified mass of mycelium. These hard fruits lie on the soil mostly two years before they germinate. In this case the young shoots are not affected by the fungus. These different fungi are well illustrated, and detailed diagnoses are given of the species.

Development of Ergot.†—Erich Tschermak writes on the conditions that favour the growth of Ergot in various cereals. A prolonged duration of the flowering season is distinctly favourable to the spread of the fungus. It does not depend on the fertility of the grain, for sterile plants often develop sclerotia in their flowers. In dry warm weather the opening of the glumes is quick and fructification is soon over, so that the chance of infection is much lessened. There are certain varieties of cereals that flower quickly and these should be preferred. Ergot is rare in barley, though the flowers at the top of the head are often open and liable to infection.

Thielavia basicola.‡—This fungus has been found growing on the roots of *Senecio elegans* and various other plants. R. Aderhold who discovered it in the roots of diseased begonias, made successful cultivations on sterilised pears, gelatin, etc. The colourless conidia were produced and later the brown forms. Aderhold then attempted to transfer the fungus to the roots of *Begonia semperflorens*, but without success. He noted also that in plants attacked, it was always at the "neck" of the roots that the fungus was situated. He does not think that it is at all an active parasite.

Germination of Sclerotia of Claviceps purpurea.§—After a series of experiments with this fungus Zimmerman sets out the results arrived

* Centralb. Bakt., xvi. (1906) pp. 188–202 (4 pls.).

† Fühling's Landw. Zeit., lv. (1906) pp. 194–9. See also Centralbl. Bakt., xvii. (1906) pp. 274–5.

‡ Arb. Biol. Abt. Land. Forstw. k. Gesundh., iv. (1905) pp. 463–5. See also Ann. Mycol., v. (1906) pp. 461–2.

§ Zeitschr. Pflanzenkr., xvi. (1906) pp. 129–31.

at in a series of statements. He maintains that sclerotia are capable of germination after being kept for two years; that a number of sclerotia in the open do not succeed in germinating the first year, but that they also germinate in the second year under favourable conditions. He found that even when mouldy or broken in pieces they produced the Peziza form, and it was immaterial whether they were kept dry during the intervening season, or were kept moist as had been thought necessary. The time of germination varied during the first half of May.

Erysiphe graminis.*—E. M. Reed's infection experiments with *Erysiphe graminis* confirm the findings of previous workers in this field as to the existence of biological species. He found that the form on rye would infect no other grass, that the same fungus on *Poa pratensis* was equally specialised, though in certain conditions it could be transferred to *P. nemoralis*, *P. trivialis*, and *P. compressa*. Other infections only confirmed the existence of biological species in the mildew of grasses.

Yeasts and Cysts in Glœosporium.†—Viala and Pacottet publish in more detail work already communicated on this subject. They add an account of their researches on *Ascochyta Pisi*, a somewhat similar fungus. During ten months of culture they got no trace of polymorphism, neither yeasts nor cysts, showing thus a considerable divergence from *Glœosporium*. A note is added on the installation of the Research Station for vine diseases.

Origin of Yeasts.‡—In discussing Viala and Pacottet's recent work on the inclusion of yeasts in the life cycle of the higher fungi, A. Guillermond points out that the fertilisation process observed before the formation of endospores rather tends to show that all such spores are from asci with a sexual origin; that the endosporic sacs described by these writers probably do not belong to *Manginia* and *Gnomonia* as they supposed.

Polymorphism of Colletotrichum.§—B. Namyslowski experimented with a species that grew on the leaves of *Poa trivialis*. In artificial cultures the conidia germinated and formed only chlamydospores. The fungus mycelium in a culture produced both chlamydospores and the typical conidiophores and conidia of *Colletotrichum*. Reinfection of *Poa* with these conidia was without result.

Hyphomycetes.‖—G. Lindau finishes the *Arthrineæ* with the three genera *Goniosporium*, *Gonatobotryum* and *Arthrinium* begun in a previous fascicle. The Trichosporieæ and Monotosporeæ are also worked through.

* Trans. Wis. Acad. Sci. Arts and Letters, xv. (1905) pp. 135–62. See also Ann. Mycol., v. (1906) p. 460.

† Ann. Inst. Nat. Agron., v. fasc. 1 (1906) 45 pp., 22 figs. See also Bot. Centralbl., cii. (1906) pp. 585–6.

‡ Comptes Rendus Soc. Biol. Paris, lx. (1906) pp. 975–7. See also Bot. Centralbl., cii. (1906) p. 583.

§ Bull. Acad. Sci. Cracovie Cl. Sci. Math. Nat., 1906, pp. 254–7 (1 pl.). See also Ann. Mycol., v. (1906) p. 468.

‖ Rabenhorst's Kryptogamen Flora, i. Abt. 8, lief 102 (Leipzig, 1906) pp. 661–704 and pp. 705–52.

The Gonatorrhodeæ with the one genus *Gonatorrhodum* is described and several genera of the Haplographieæ. In the succeeding fascicle he carries on the descriptions down to the suborder Chalareæ, which includes genera that bear simple chains of conidia. He has already described 1473 species of Hyphomycetes.

Uredineæ.—Ed. Fischer* gives the details of a series of experiments with various heterœcious Uredineæ. He finds that *Uromyces graminis*, which forms its æcidia on *Laserpitium Siler*, is not identical with the one that has *Seseli glaucum* as its alternate host. He gives some of his experiences with the germination of the teleutospores. Following Eriksson's advice as to cooling the spores, he soaked the leaves with the teleutospores in water, and the second night after he had a plentiful formation of basidia and sporidia. Infection experiments were also carried out with the teleutospores of *Puccinia liliacearum* on *Ornithogalum*. Fischer found considerable variability when it was grown on different hosts.

Walter Krieg † has worked with the æcidia of various species of *Ranunculus* and their Puccinia-forms on different Gramineæ. Results are given.

Wilhelm Müller ‡ has been experimenting with the Melampsoræ on *Euphorbia* and *Hypericum*. Most of the species are autœcious, but the Uredo hosts of *Æcidium Euphorbiæ-gerardianæ* belong to the genus *Ononis*. *Melampsora hypericorum*, which was said to grow on eleven species of *Hypericum*, is so far specialised that the form on *H. montanum* would grow on no other host, and must be designated *Mel. Hyperici-montani*.

A long series of researches on the specialisation of *Puccinia* on Labiatæ is published by Paul Cruchet.§ He gives the lists of plants on which he made the inoculation experiments. The first part, including eleven series of infections, is devoted to *P. Menthæ*.

L. Hecke ‖ has attempted, by means of inoculation experiments, to explain the presence of *Puccinia Maydis*, the rust of maize, which is found wherever maize is cultivated. Arthur had established the heterœcious nature of this rust, its æcidium growing on *Oxalis*, though it is rare, even in America, to find this stage of the fungus. Only once has an *Æcidium* been recorded in Europe on *O. corniculata*. Hecke inoculated plants of various species of *Oxalis* with the teleutospores of *P. Maydis* with varying results: *O. stricta* was most readily and constantly infected; with *O. tropæoloides* infection was slower and not so abundant; on *O. rosea* spermogonia alone were produced; while only spots without any fruit formation resulted from inoculation of *O. valdiviana*. The æcidiospores from *O. stricta* were employed to reinfect the maize, with immediate successful production of the uredospores. All attempts to inoculate maize with its own teleutospores failed. The author then discusses the theories as to the origin of the disease. The Æcidium stage is of too rare occurrence to account for the universal appearance of the rust. Experiment has proved that the teleutospores

* Centralbl. Bakt., xvi. (1906) pp. 203–8.
† Tom. cit., pp. 208–9.
‡ Tom. cit., pp. 210–211.
§ Tom. cit., pp. 212–24.
‖ Ann. Mycol., v. (1906) pp. 418–20.

are not the source of infection. It is possible, however, that the uredospores may persist during the winter in the more southerly regions of Europe, and that the disease may spread towards the north; or Eriksson's theory of some mycoplasma or disease inherent in the plant may have to be considered.

P. Dietel * describes a new genus of Uredineæ from India, *Chnoopsora*, a member of the Melampsoraceæ. In honour of its finder, the author names it *C. Butleri*. The æcidia are unknown; the teleutosori are widely diffused over the under-surface of the leaves of *Adhatoda vesica*; they are developed under the epidermis and are usually one-celled. They do not all develop simultaneously.

H. and P. Sydow with E. J. Butler † publish a first list of Fungi from different districts of India. This first instalment includes only Ustilagineæ and Uredineæ. Descriptions and localities are given of many of the forms and a large number are new.

E. W. D. Holway ‡ has issued Part II. of the first volume of North American Uredineæ, containing the descriptions of thirty-eight species following the natural orders of the host-plants.

S. Kusano § in notes on Japanese Fungi records two new Uredineæ, *Uromyces* on *Cladastris* and *Cæoma* on *Prunus*. The latter attacks the twigs at an early stage and causes considerable deformation of leaves and flower buds.

T. Miyake ‖ has made a study of the *Pucciniæ* parasitic on species of Umbelliferæ in Japan. He records in all eighteen species, several of them only found in Japan.

J. C. Arthur ¶ continues his paper on a "New classification of the Uredinales." His method involves a knowledge of the life-history of the species, including the number of spore forms, and the structure of the sorus. Hitherto, any form with a two-celled teleutospore has been called a *Puccinia*; under the new system, all the life stages must be considered before the form is placed with its proper genus. The author allows that his method is somewhat lacking in simplicity.

New Fungus of Cereals.**—J. R. Jungner-Posen found on rye that had been attacked by eel-worms, white pustules of mycelium that in time turned to sclerotia, small reddish-brown bodies the size of a clove seed. In four to six weeks after the collection of the sclerotia, small agarics were developed which proved to belong to a new species named by the author *Psilocybe Henningsii*. A full diagnosis of the agaric is given and a further growth of mycelium and conidia on the diseased leaves is described. Jungner-Posen was unable to determine the connections of the latter, if any, with the sclerotial fungus.

* Ann. Mycol., v. (1996) pp. 421–3 (1 fig.). † Tom. cit., pp. 424–45.
‡ North American Uredineæ, i. part 2, Minneapolis, 1906). See also Ann. Mycol., v. (1906) p. 454.
§ Bot. Mag. Tokyo, xix. (1905) pp. 83–5; xx. (1906) pp. 47–57 (2 pls.). See also Ann. Mycol., v. (1906) pp. 455–6.
‖ Journ. Sapporo Agric. Coll., ii. (1906) pp. 97–132 (1 pl.). See also Ann. Mycol., v. (1906) pp. 457–8.
¶ Journ. Mycol., xii. (1906) pp. 188–91.
** Zeitschr. Pflanzenkr., xvi. (1906) pp. 131–5 (1 pl.).

Development of Hypholoma.*—Caroline L. Allen publishes the results of her examination of several species of *Hypholoma*. The method of growth was so similar in all that they might have ranked as one species. She sums up thus:—(1) The hymenium of *Hypholoma sublateritium* and allied forms is endogenous in its origin. (2) A universal veil (primordial cuticle) is present from the beginning. (3) Pileus, hymenium, lamellæ, and upper portion of the stipe are formed by the growth and differentiation of a small central area of tissue. (4) The gill cavity is formed internally after the formation of the hymenial primordium by breaking of the hyphæ beneath this. (5) The lamellæ are formed by the unequal growth of the hyphæ of the hymenial primordium. (6) In one species, the cystidia appear at a very early stage and soon attain their highest development, being much more prominent then, than in the mature plant. Differentiation of tissue begins when the plant is about 1 mm. high, and reaches an advanced stage before it is 5 mm. high.

Development of Agaricus campestris.†—G. F. Atkinson has brought together the studies and theories of many workers as to the growth of the fruit-body of the mushroom and allied fungi, and he adds the results of his own observations. He notes first the primordium of the carpophore, a homogeneous body composed of slender, uniform, dense hyphæ surrounded by an outer layer, the universal veil. The formation of the hymenium, which is endogenous in its origin, is followed in detail and the differentiation of stipe and pileus. In cultivated forms the basidium bears two spores only, the wild plants have four spores.

Question of Species in Parasitic Fungi.‡—Ed. Fischer explains the existence of biological and physiological species so often found among the Uredineæ and discusses their position in any practical system of classification. He concludes that those forms which constantly show morphological differences must rank as species. Other forms which differ from each other only slightly should be united in collective species, and those biologically different should rank as sub-species.

Plant Diseases.—J. B. S. Norton § gives descriptions of various fungoid diseases that attack potatoes, with the treatment necessary in each case. The chief of those mentioned are caused by *Oospora scabies*, *Rhizoctonia*, *Fusarium oxysporium*, *Bacillus solanacearum*, *Alternaria Solani*, and *Phytophthora infestans*.

The ripe rot or Mummy Disease of guavas has been studied by J. L. Sheldon ‖ who finds that it is caused by *Glœosporium Psidii* with a perfect fruiting stage belonging to the genus *Glomerella*. He describes the development of the fungus.

H. Fassi¶ describes a new species of *Leptosphæria* which he found

* Ann. Mycol., v. (1906) pp. 387–94 (3 pls.).
† Bot. Gazette, xlii. (1906) pp. 241–64 (6 pls.).
‡ Ver. Schweiz. Nat. Ges. Luzern, lxxxviii. (1906) pp. 300–8 (6 figs.).
§ Maryland Agric. Exper. Stat. Bull., cviii. (1906) pp. 63–72 (4 figs.). See also Bot. Centralbl., cii. (1906) p. 497.
‖ West Virginia Agric. Exper. Stat. Bull., civ. (1906) pp. 299–315 (4 pls., 29 figs.). See also Bot. Centralbl., cii. (1906) p. 498.
¶ Bull. Lab. ed Orto Bol. Siena, vii. (1905) pp. 57–62 (1 pl.). Seo also Bot. Centralbl., cii. (1906) p. 471.

growing on the branches of *Lygeum Spartium* along with *Hendersonia Spartii*. He describes these and other forms.

H. Detmann * publishes observations on plant diseases in Baden. He notifies among others the appearance of *Peronospora viticola* on the vines. *Puccinia simplex* and *P. graminis* were recorded many times. Mildew of the quince was more wide spread and more virulent than in previous years. Suggestions are given as to remedies.

Plant parasites in Holland form the subject of another communication.† Species of *Peronospora* did much damage to rose trees, salad and clover. *Peridermium Strobi* was discovered on a Weymouth pine. *Exoascus* appeared for the first time in Holland on cherries. *Cladosporium herbarum* was frequently found; it caused considerable loss to the grain harvests. *Sphærella brunneola*, *Fusarium roseum*, *Sclerotiniæ*, and species of *Botrytis* are recorded on cultivated plants. *Fomes annosus* also ranks as a harmful parasite; it was found that it had developed along the mouse tracks, and the view is hazarded that mice may aid in the spread of the fungus.

R. Solla ‡ reports on harmful fungi in Italy. These include *Monilia cinerea* on plum trees, *Botrytis vulgaris* on roses, *Ustilago Maydis* and *Tilletia Tritici* on corn. A new species, *Phyllosticta mespilicola*, was found on the leaves of *Mespilus germanica*, and a *Coniothyrium* was spotting and destroying willow leaves. *Urophlyctis Alfalfæ* was found by V. Peglion forming its galls on the roots of *Alfalfa*, and various other forms are also recorded along with instances of attack by Bacteria.

N. Ranojéwic § describes the work done at the agricultural research station at Belgrade during the years 1903–5. He records wide-spread mischief caused by *Plasmopara viticola* on vines, and he gives the results of the treatment of the diseased plants with Bordeaux mixture. A long list is given of the parasites and hosts among the cultivated plants. Insect pests occupy a large part of the paper.

K. Malkoff Sadovo ‖ reports on diseases from Bulgaria, and tells of successful applications of spraying mixtures. These were of distinct advantage in combating attacks of *Ascochyta Pisi* and *Exoascus deformans*.

E. Rostrup ¶ states that 146 cases of plant diseases were referred to him during the year, affecting cereals, fodder, leguminous plants, and roots.

W. Carruthers ** has reported on 37 cases of plant diseases in England occurring in field and garden crops, and on various trees.

F. D. Heald †† writes on plant diseases in Nebraska during 1905.

* Zeitschr. Pflanzenkr., xvi. (1906) pp. 142–4. † Tom. cit., pp. 144–6.

‡ Tom. cit., pp. 147–9.

§ Tom. cit., pp. 207–12.

‖ Jahresb. Staatt. Landw. Versuchst. Sadovio, Bulgarien, 1904, 242 pp., 8 pls. See also Zeitschr. Pflanzenkr., xvi. (1906) pp. 212–13.

¶ Tidssk. Landbrugets Planteavl, xl. (Kopenhagen, 1904) pp. 395–421. See also Zeitschr. Pflanzenkr., xvi. (1906) pp. 213–15.

** Journ. Roy. Agric. Soc, lxv. (1904) and lxvi. (1905). See also Zeitschr. Pflanzenkr., xvi. (1906) pp. 215–17.

†† Nebraska Agric. Exper. Stat. Report, xix. (1906) pp. 20–60.

He divides his subject into diseases of tree fruits, small fruits, garden vegetables, cereals, etc.

The same writer* has worked out a black rot of apples due to the fungus *Sclerotinia fructigena*. Spraying with Bordeaux mixture is advised.

N. Speschnew † notes a curious occurrence of *Plasmopara viticola* on vine leaves; round yellow balls, composed of hyphæ and spores, occurred instead of the usual felting of hyphæ. It was probably to be explained by insect action.

Speschnew ‡ gives an account of some new or little known parasites of the mulberry. *Fusarium Schawrowi* sp. n. grew on the twigs; *Leptoglœum Mori* attacked both twigs and leaves.

P. Voglino,§ in Italy, reports on a large number of cases of plant diseases of field and garden crops for the year 1904. A number of new species that had been described by G. Scalia are included in the survey. He found a species of the new genus *Oidiopsis sicula* living in the leaves of an *Asclepias*. Voglino also notices E. Cazzani's account of *Peronospora cubensis* which had worked harm to melon plants.

J. Ritzema Bos ‖ devotes a long paper to the consideration of the diseases of the various forms of *Brassica* more especially those caused by a species of *Phoma*. The fungus attacks both the leaves and the stalk, and he found that the one he was studying agreed most nearly with *Ph. oleracea*, hitherto recorded on dead stalks of *Brassica* and other Cruciferæ. The roots of the plants attacked seem as if eaten by insects, but mycelium is always to be detected at the injured parts, giving the tissue a yellowish brown appearance. The author did not find that the seed conveyed disease, but he warns cultivators against the practice of leaving diseased portions of plants in the field, and also against the transplanting of seedlings already diseased.

A plantation of 600 mulberries in Italy was destroyed by some unknown disease. After the 4-year old plants had been put in the new soil they dried up just as they began to form buds. Root trouble was suspected, or some mismanagement in planting. V. Peglion¶ found that the stems were covered with small black wart-like bodies, the stromata of the fungus *Giberella moricola*, and that the red tubercles of *Fusarium lateritium*, the conidial forms, were also present. He proved that the disease was entirely caused by these organisms. He recommends disinfection of young trees by Bordeaux mixture.

G. Lüstner** has been studying a disease of cherry-trees in the Rhine valley, said to be due partly to the fungus *Cytospora rubescens*, and

* Nebraska Agric. Exper. Stat. Report, xix. (1906) pp. 82–91 (2 pls.). See also Bot. Centralbl., cii. (1906) p. 559.

† Monit. Jard. Bot. Tiflis, livr. 2 (1906) pp. 1–2.

‡ Arb. Kaukas Stat Seidenzucht, Tiflis, x. heft 2 (1905) pp. 30–41 (2 pls.). See also Bot. Centralbl., cii. (1906) p. 567.

§ S.A. Ann. R. Accad. Agric. Torino, 1904, 87 pp.. See also Zeitschr. Pflanzenkr., xvi. (1906) pp. 276–80.

‖ Zeitschr. Pflanzenkr., xvi. (1906) pp. 257–76 (13 figs.).

¶ Atti R. Accad. dei Lincei (1906) No. 1. See also Centralbl. Bakt., xvii. (1906) pp. 279–80.

** Ber. k. Lehranst. Wein. Obst. Garten. Geisenheim a Rh., 1904, p. 225. See also Bot. Centralbl., cii. (1906) p. 586.

partly to weather conditions. He thinks that the parasitism of the fungus is doubtful, and that the destruction of the trees is brought about by soil and weather conditions.

L. Rougier * publishes his experiences in the extermination of the disease Black-rot in the vine. He advises the employment of a mixture containing acetic acid rather than the Bordeaux mixture for spraying the trees.

P. Baccarini † notifies the disease of leaves of a hot-house plant *Winterana canella*. The leaves attacked are paler in colour, and show round, olivaceous spots on the under side about a centimetre in diameter. He found the spot infested by a fungus, a somewhat torulose brownish mycelium, with two-celled elliptical gonidia. He has identified the fungus with *Cycloconium oleaginum*, an endophytic parasite.

American Mycology.—W. A. Kellerman ‡ describes in great detail a new species of microfungi, *Plowrightia Williamsoniana*, from Guatemala; it caused a disease of the American century plant, *Agave americana*, attacking and finally destroying the leaves. It is conspicuous on account of its red or yellowish-red colour.

A new anthracnose of *Alfalfa* and red clover, due to the fungus *Colletotrichum Trifolii*, is recorded by Samuel M. Bain and Samuel N. Essery.§ The clover is most susceptible to attack when the seedlings encounter the first prolonged hot spells of summer, when the petioles are attacked, and again as the seed is ripening when the stems at or below the surface of the ground become diseased.

G. F. Atkinson ‖ publishes diagnoses of two new species of Agarics from Central Ohio:—*Naucoria paludosella*, which grew on living *Sphagnum*, other mosses, and on rotten wood; *Stropharia Hardii*, which is distinguished by its rooting base.

A. P. Morgan ¶ continues his monograph of North American species of *Lepiota*. The present instalment includes 29 species. Very few of them are British species; several of them are described by Morgan for the first time.

G. G. Hedgcock** gives a list, with diagnoses, of some wood-staining fungi from various localities in the United States. These belong to the genera *Ceratostomella*, *Graphium*, *Fusarium*, *Hormodendron*, *Hormiscium*, and *Penicillium*. The colours induced by them on the wood are all of a dark or dirty colour, blue-black and brown, with the exception of two species, *Fusarium roseum*, which stains pine sapwood pink to lilac, and *Penicillium aureum*, which gives the same wood a yellow or red colour.

Toxin of Aspergillus fumigatus.††—E. Bodin and L. Gautier had found that there was no poison in the cultures of this fungus; but more recently they detected some in cultures which contained, besides pepton, a carbohydrate, glucose, or some similar substance. This was injected

* Rev. Vilic., xxiv. (1905) pp. 713–19. See also Bot. Centralbl., cii. (1906) pp. 584–5.
† Nuov. Giorn. Bot. Ital., xiii. (1906) pp. 281–7 (3 figs.).
‡ Journ. Mycol., xii. (1906) pp. 185–7.
§ Tom. cit., pp. 192–3.
‖ Tom. cit., pp. 193–4 (1 pl.).
¶ Tom. cit., pp. 195–203.
** Tom cit., pp. 204–10.
†† Ann. Inst. Pasteur, xx. (1906) pp. 209–24. See also Ann. Mycol., v. (1906) pp. 465–6.

into animals and acted strongly on the nerves. The nature of the toxin was not demonstrated.

Results of Disinfecting with Formaldehyde.* — J. Schorstein washed some timber that was infected with a Hymenomycete with a 40 p.c. solution of formaldehyde, and, in a few days, found that the mycelium of some fungi (*Merulius*, *Polyporus*) grew luxuriantly on it. The explanation he gives is that organisms such as bacteria and protozoa which hinder the growth of the mycelium had been killed; but not the fungus which was embedded in the wood. He argues that such a solution as formaldehyde is useless in combating dry-rot.

Fungi Occurring in the Preparation of Soya.†—K. Saito finishes his paper on this subject, begun in a previous issue. He finds a number of organisms associated with the process of Soya preparation, and he considers that almost all of them are necessary to produce the desired effect. *Aspergillus Oryzæ* plays an important part in converting starch into sugar, and splitting the albumens of the Soya beans and corn. *Rhizopus japonicus* and *Tieghemella hyalospora*, which are also found in Soya, are unnecessary if not objectionable. Various yeasts, species of *Saccharomyces*, are indispensable; two new bacteria are also recorded.

Another substance, called "Tamari," was also examined by Saito, and in the beancakes used in its preparation he isolated *Rhizopus Tamari* sp. n., *Aspergillus glaucus*, *A. Rehmii*, and *Circinella mucoroides* sp. n. Descriptions of the new species are given.

ABDERHALDEN, E., & Y. TERUUCHI—**Kulturversuche mit Aspergillus niger auf einigen Aminosäuren und Peptiden.** (Culture experiments with *Aspergillus niger* on some amino-acids and peptids.)
Zeitschr. Phys. Chemie, 1906, p. 394. See also *Ann. Mycol.*, v. (1906) pp. 464–5.

ABDERHALDEN, E., & P. RONA—**Die Zusammensetzung des "Eiweis" von Aspergillus niger bei verschiedener N. Quelle.** (The synthesis of albumen of *Aspergillus niger* with different sources of nitrogen.)
Op. cit., xxxvi. (1905) pp. 179–87. See also *Ann. Mycol.*, v. (1906) p. 465.

ARTHUR, J. C.—**New Species of Uredineæ. V.**
[The species were collected in Canada, the States, Mexico, and West Indies.] *Bull. Torrey Bot. Club*, xxxiii. (1906) pp. 513–21.

CROSSLAND, C.—**Yorkshire Naturalists at Flamborough.**
[A list of the Fungi and Myxomycetes collected on the excursion is given.]
Naturalist, Aug. 1906, pp. 261-2.

DIEDICKE, H.—**Neue oder seltene Pilze aus Thüringen ii.** (New or rare fungi from Thuringia.)
[A number of microfungi belonging to different orders are described; some of them are new to science.] *Ann. Mycol.*, v. (1906) pp. 412–17 (12 figs.).

FISCHER, ED.—**Ueber einige von Herrn Prof. E. Kissling in Sumatra gesammelte Pilze.** (On some fungi collected by Prof. E. Kissling in Sumatra.)
[There is one new species of *Pisolithus*; other fungi are described.]
Mitt. Nat. Ges. Bern, (1906) 15 pp., 1 pl. See also *Bot. Centralbl.*, cii. (1906) p. 451.

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* Zeitschr. Landw. Ver. Oesterr., 1905, heft 6. See also Centralbl. Bakt., xvii. (1906) pp. 270–1.
† Centralbl. Bakt., xvii. (1906) pp. 152–61 (5 pls.).

KELLERMAN, W. A.—**Mycological Bulletin, Ohio State University. III.-IV.**
[Contain notes on many species of fungi.]
June 1905–April 1906, Nos. 36–56, pp. 141–224, figs. 115–76.
See also *Bot. Centralbl.*, cii. (1906) p. 528.

PECK, CHARLES H.—**A New Species of Galera.**
Journ. Mycol., xii. (1906) p. 148 (1 pl.).

RACIBORSKI, M.—**Einige Chemomorphosen des Aspergillus niger.** (Chemomorphism of *Aspergillus niger.*)
[Action of various solutions on the growth of the fungus.]
Zeitschr. Angew. Mikrosk. Klin. Chemie, xii. (1906) pp. 131–9.

REHM, H.—**Zum Studium der Pyrenomyceten Deutschlands, Deutsch-Oesterreichs und der Schweiz.** (The study of the Pyrenomycetes of Germany, Austria, and Switzerland.)
[Genera and species of *Massariacei* are listed and described. One new species, *Massaria scoparia*, is described.]
Ann. Mycol., v. (1906) pp. 395–403.

„ „ **Ascomycetes exs. Fasc. 37.**
[Notes and descriptions of Ascomycetes recently issued. Several of the species are new to science.]
Ann. Mycol., v. (1906) pp. 404–11.

RICKER, P. L.—**A List of known Philippine Fungi.**
[The list is compiled from the papers published by various collectors and students, and is meant as a basis for future work.]
Philippine Journ. Sci., i. (1906) pp. 277–94.

RYTZ, W.—**Beiträge zur Kenntniss der Gattung Synchytrium.** (Contribution to the study of the genus *Synchytrium.*)
[The author describes the spore germination of three species.]
Centralbl. Bakt., xvi. (1906) p. 511.

SACCARDO, P. A.—**Fungi aliquot africani.** (Some African fungi.)
[Some forty species are listed; several of them are new to science.]
Bol. Soc. Brot., xxi. (1906). See also *Bot. Centralbl.*, cii. (1906) p. 413.

SPESCHNEW, N. N.—**Mykologische Bemerkungen.** (Mycological observations.)
[Notes on *Discosia Rhododendri* sp. n., *Harzia acremonioides*, and *Erysiphe Ricini* sp. n.] *Moniteur Jard. Bot. Tiflis*, livr. 4 (1906) pp. 10–15 (with figs.). See also *Bot. Centralbl.*, cii. (1906) p. 585.

WILL, H.—**Beiträge zur Kenntniss der Sprosspilze ohne Sporenbildung, welche in Brauereibetrieben und deren Umgebung vorkommen.** (Contributions to the knowledge of yeasts without spore formation, which occur in breweries and their neighbourhood.) *Centralbl. Bakt.*, xvii. (1906) pp. 137–46.

ZELLNER, J.—**Ueber das fettspaltende Ferment der höheren Pilze.** (On the fat-splitting ferment of the higher fungi.)
[The process was found to be fermentative, but the ferment has not been isolated.] *SB. k. Akad. Wiss. Wien Math.-Nat. Kl.*, cxv. (1906) pp. 119–28. See also *Hedwigia*, xlv. (1906) Beibl. p. 174.

ZIKES, H.—**Ueber Anomalus Hefen und eine neue Art derselben Willia Wichmanni.** (On anomalous yeasts and a new species, *Willia Wichmanni.*)
Centralbl. Bakt., xvi. (1906) p. 97. See also *Bot. Centralbl.*, cii. (1906) p. 416.

Lichens.

(By A. LORRAIN SMITH.)

Parasitic Lichens on Endocarpon.*—Wilhelm Hofman has studied this question of parasitism in connection with the growth of *Lecanora*

* Beitr. wiss. Bot., 2te Abt. v. (1906) pp. 259–74. See also Bot. Centralbl., cii. (1906) pp. 452–3.

dispersa, *Parmeliopsis hyperopta* and *Lecanora spec.* which live on *Endocarpon miniatum* a very common lichen in the neighbourhood of Stuttgart. He found that the host lichen was very seriously affected and in some cases quite destroyed by the parasite. The gonidia and perithecia suffer first, and finally the hyphæ. The parasitic lichen is also affected by its habitat, the gonidia and apothecia are larger, and the gonidial layer occupies half of the whole thallus.

CLAUDEL, H. & S., & J. HARMAND—**Lichenes Gallici.** (French lichens.)
[A list of 50 species, Nos. 301-50 including a great variety of plants.]
Docellus Vogesorum, 1905, fasc. vii. See also *Bot. Centralbl.*, cii. (1906) p. 452.

ZAHLBRUCKNER, A.—**Schedæ ad "Kryptogamas exsiccatas" editæ a Museo-Palatino Vindobonensi, Centuria xii.-xiii.**
[A list of lichens is included.]
Ann. Naturhist. Hofmuseums Wien, xx. [1905] 1906, pp. 1-48. See also *Bot. Centralbl.*, cii. (1906) pp. 498-504.

Mycetozoa.

Myxomycetes of Switzerland.*—H. Schinz has provided the first publication of these organisms for Switzerland. He enumerates 106 species collected over the whole of the country, and many of them found over and over again. The author records 25 species that were found at altitudes of over 1600 metres. Keys to the genera and species have been provided by A. Lister, and these include foreign forms also, as later they may be found in Switzerland.

Harmful Myxomycete.†—Thorild Wulff records the various cases in which Myxomycetes have been known to do damage to plants, and he then proceeds to describe an unusually large development of *Physarum cinereum* on a grass meadow in Sweden. Large stretches were overspread by the *Physarum* and owing to the sporocyst formation took on a grey colour. The grass was completely smothered by the large mass of the myxomycete. The meadow in question was formed into experimental culture plots, and it was found that the myxomycete spread most widely on the unmanured portions. A detailed description of the organism is given by the author.

FRIES, ROB. E.—**Myxomycetenfloran i de jämtländska fjällträkterna.** (A list of Swedish Myxomycetes.) *Arkiv Bot.*, vi. No. 7 (1906) 9 pp.

Schizophyta.

Schizomycetes.

Formation of Slime or Gum by Rhizobium leguminosarum.‡ R. Greig Smith believes that the direct fixation of nitrogen may not be the function of Rhizobium, but nitrogen is fixed by the plant and the microbe assists in the process. *Vibrio denitrificans* converts the combined

* Mitth. Naturwiss. Ges. Winterthur., vi. (1906) 129 pp., 45 figs. See also Bot. Centralbl., cii. (1906) p. 530.
† Zeitschr. Pflanzenkr., xvi. (1906) pp. 202-6 (1 pl.).
‡ Proc. Lin. Soc. N.S.W., 1906, p. 264.

nitrogen of nitrates into free nitrogen, and the gums produced by both these organisms are identical. The slime is simply the capsule of the organism that has become swollen; thus the formation of bacteroids depends on the chemical nature of the capsules of the bacteria, and is not connected with any fixation of nitrogen that may occur within the plant. Probably the plant is able to use the bacterial slime to build up its nucleoprotein. The symbiosis between host and bacterium relates to the alteration of carbohydrates and not to the fixation of nitrogen. The function of the micro-organism in the nodule is to produce slime which is closely related to the carbohydrates of the nucleoproteid molecule of the plant.

Direction of Growth of Bacteria in Gelatin.*—H. C. Jacobsen from observations on *B. zopfii* finds that the direction of the mathematical curves of growth of the thread forms in gelatin, is that of the resultant tension, and perpendicular to the pressure strain, and that this organism has a property of reacting by an elastic tension to which the author gives the name of "Elasticotropie."

Cultivation of Tubercle Bacilli after Disinfection by Formaldehyde and by Singeing.†—C. Spengler obtained growth of tubercle bacilli from sputum after exposure to 48 hours action of formalin, all accompanying bacteria being killed. Disinfection by singeing consists in the partial sterilisation of the sputum by heat: portions the size of a hazel nut held on a platinum loop are passed through the flame, and inoculations are made on blood-agar, or glycerin-agar. The author points out that the inactivity of the bactericidal function of the leucocytes in the sputum is to be considered.

Streptococcus capsulatus gallinarum.‡—Dammann and Manegold isolated from the body of a fowl dead with appearances of hæmorrhagic septicæmia, a capsulated streptococcus. The number of cocci in a chain varied according to the medium from 30–100; individual cocci measured $0\cdot3\,\mu$–$0\cdot5\,\mu$; motility was absent; the capsule was only manifest in those streptococci grown in the animal body. Growth was aerobic and anaerobic, good on blood serum and in milk, but less on meat extract, broth, gelatin, and agar; acid and small amounts of indol are formed in saccharose broth; gelatin is not liquefied; it is very susceptible to drying by heat and to the action of antiseptics.

Incubation of the inoculated disease varied from 6–30 days, in one case as long as 60 days. It is pathogenic for rabbits and mice, and especially for pigeons; dogs, ducks, and guinea pigs are not susceptible.

Ætiology of Syphilis.§—W. Mühlmann finds that the *Cytorrhyctes luis* is not a flagellated protozoon, but represents neutrophil granules of leucocytes. He proposes to name them "Granulocytes."

Morphology of Spirochæta pallida.‖—M. Forest advocates the following method for examination of Spirochætæ. The tissue fluid is

* Centralbl. Bakt., 2te Abt. xvii. (1906) p. 53.
† Op. cit., 1te Abt. Ref. xxxix. (1906) p. 24. ‡ Tom. cit., p. 60.
§ Op. cit., Ref. xxxviii. (1906) p. 745.
‖ Op. cit., 1te Abt. Orig. xlii. (1906) p. 608.

spread on a cover glass and fixed moist in osmic acid or formalin vapour; stained with Giemsa's solution (10–15 drops to 10 of aq. dist.) for 12–16 hours, the stain being warmed to steaming point during last ½ hour; then wash in running water for 2 minutes. The spirochætes take a deep red colour, the flagella appearing as fine wavy processes of various lengths, at times having a band-like form. Most spirochætæ of Schaudinn type have a flagellum at either end, those with only one have probably lost one. Whether spirochætæ belong to Bacteria or Protozoa is still disputed, the undulatory membrane of Schaudinn and others not being generally accepted. As yet cultural experiments have been without result.

Differentiation of Capsulated Bacteria by Agglutinating and Precipitating Immune Sera.*—M. v. Eisler and O. Porges succeeded in so altering the bodies of capsulated bacteria that an agglutinable suspension was possible. The bacteria were heated in an acid solution, the protein of the capsules being hydrolysed, and after neutralising in the cold, it was possible by means of the usual manipulations to obtain specific agglutination reactions.

The sera employed in the agglutination and precipitation experiments were obtained by subcutaneous injection of sterilised emulsions of agar cultures. The results of the precipitation experiments agreed with those of the agglutination experiments when applied to differentiate *B. friedländeri*, *B. rhinoscleromatis* and *B. ozænæ*.

Bacterium Pneumoniæ simile.†—P. G. Woolley in studying febrile splenomegaly, has isolated from one case, an organism in pure culture from the spleen, not from other organs.

The bacillus formed minute translucent moist colonies on glycerin agar, and on coagulated horse serum. In glucose, saccharose and inulin broths it formed a fine flocculent sediment: milk was acidified in 24 hours, coagulated in 72 hours, and the casein subsequently separated leaving, in about 6 days, a clear pink supernatant whey. The organism thrives best in milk and on potato. There is no formation of indol, and only slight fermentation of sugars; it is non-motile; does not form spores; stains by Gram's method, and in appearance is a small polar stained bacillus, resembling the plague bacillus. It was pathogenic to monkeys. The author suggests that this organism may be one of the causes of tropical splenomegaly.

Bacterial Disease of Zingiber officinale.‡—Y. Uyeda describes a disease occurring in this plant in Osaka. Bacteria in almost pure culture were found at the bases of the young sprouts, extending also in the root and sprouts and causing the leaves to wither. Pure cultures were obtained by plating, and inoculation from these into the sprouts of healthy plants reproduced the disease in typical form. The organism resembles *B. omnivorus*. It forms no spores, is not motile, and does not liquefy gelatin; it does not stain by Gram's method; it forms a

* Centralbl. Bakt., 1te Abt. Orig. xlii. p. 660.
† Tom. cit. (1906) p. 589. ‡ Op. cit., 2te Abt. xvii. (1906) p. 383.

pellicle on broth; on pepton agar it develops a strong odour of trimethylamine; it is aerobic.

Bacterial Rot of Potato.*—F. C. Harrison has isolated a bacillus from potato rot. The organism was cultivated upon a large number of media, and many varieties of vegetables became affected after inoculation. Only slight growth occurred under anaerobic conditions; fifty minutes' exposure of agar plates to sunlight served to inhibit the production of colonies; optimum temperature 25°–28° C.; good growth was obtained at 40° F. (4·44° C.) and slight growth in cold storage room at 35° F. (0·56° C.). The thermal death point was 54° C. for 10 minutes.

There was slight production of indol in Dunham's solution on warming, after 7 days' growth at 25° C. After 3 days at 25° C. in nitrate broth, abundant nitrite had been produced. It was nonpathogenic for laboratory animals.

The author suggests the following precautions against the disease: plant rot resisting varieties and seed free from all rot, in well drained land; reduce number of insects by Paris green, and growth of fungi by Bordeaux mixture; rotation of crops.

Bacterioscopic Analysis of Excremental Pollution.†—A. MacConkey, referring to E. Klein's note,‡ points out that the first kind of bile salt broth was one containing not glucose, but lactose, which was to be preferred if search is being made for typical *B. coli* only. The change to glucose was made so as to include other organisms such as *B. enteritidis*.

The addition of "Fleischwasser" or of "beef extract," decreases the selective action of bile salt media, and it is upon this selective action that the value chiefly depends. *B. pestis* and *B. pseudo-tuberculosis rodentium* grow well, but the bacilli of fowl cholera show very little, if any, multiplication on bile salt media. The author finds that the selective action extends to different strains of the same bacillus, a virulent *B. typhosus* growing better than a nonvirulent one.

The Occurrence and Distribution of Azotobacter chroococcum in different soils.§—H. R. Christensen finds that the occurrence and distribution of this organism is connected with the amount of calcium carbonate in the soil. From the amount of growth of Azotobacter from a definite amount of soil in a nutrient fluid medium containing mannite and phosphate of calcium it is possible to obtain a biological expression of the calcium carbonate content of the soil; but this can be more accurately obtained by using pure culture of Azotobacter. Certain phosphates of calcium and sodium are favourable to the growth of Azotobacter; the relations of its growth to phosphates and different salts of calcium seem to justify the expectation that it may be possible

* Centralbl. Bakt., 2te Abt. xvii. (1906) p. 384.
† Brit. Med. Journ. 1906, ii. p. 1521.
‡ See this Journal, 1906, p. 728.
§ Centralbl. Bakt., 2te Abt. xvii. (1906) p. 378.

from a biological medium, to obtain an expression for the plant nourishment content of the soil.

The presence of a certain amount of phosphoric acid (and chalk) in the soil is needed for the fermentation of mannite.

Two anaerobes of Butyric acid group that produce no butyric fermentation in Milk.*—A. Rodella describes two organisms of the butyric acid group, which in milk do not cause butyric acid fermentation. (1) A slender bacillus staining by Gram's method, and forming small round spores; on gelatin growth is delayed, the colonies being woolly and not compact as on agar; growth is slight in ordinary broth, but in Beijerinck's fluid it is vigorous; no growth occurs on potato; milk is a favourable medium, but itself seems to undergo no change save slight rise in acidity; the butyric acid formed in milk is negligible, but in Beijerinck's fluid it is formed, associated with certain amounts of lactic acid. (2) Bacilli 3–5 μ long and 1 μ broad, staining by Gram's method and growing well on gelatin; there is good growth in milk, which is coagulated, the clot not being dissolved; from the fermentation of milk sugar lactic acid is exclusively formed. In Beijerinck's fluid it forms besides butyric acid large amounts of valerianic acid.

Spirillosis of embryo Chick.†—C. Levaditi introduced blood containing spirilla into the whites of fecundated eggs—and incubated these at 40° C. The spirilla remained alive and multiplied only in germinating eggs, when a spirillar infection of the embryo resulted. The greater pathological changes occurred in the liver; phagocytosis of spirilla by the leucocytes of the blood and the macrophages of the liver, the cells of Kuffler being packed with spirilla. Spirillosis of the embryo is more severe than in the adult, and does not terminate in a disappearance of the spirilla in the general circulation.

The author found also that the *Spirillum bresiliense* is not transmissible from infected hens to their embryo; and that these embryos are immune against the infection of *Spirillum gallinarum*.

Experimental Glanders of Guinea Pigs.‡—C. Nicolle finds that B. mallei obtained from the horse is usually active against guinea pigs and mice, little or not at all active against rabbits, except after repeated passages through guinea pigs, the same bacilli not increasing in virulence for guinea pigs. The virulence is diminished for rabbits and still more so for mice after repeated passages through rabbits; the virulence is increased for rabbits, mice, and guinea pigs after passing through mice.

Bacteriosis of the Fig-Tree.§—L. Petri isolated from diseased fig-trees a bacterium which is the cause of the malady. He identifies it with *Ascobacterium luteum*, an organism described by Babès in 1890. Its most characteristic features are the formation of zoogloea masses and the

* Centralbl. Bakt., 2te Abt. xvii. (1906) p. 374.

† Ann. Inst. Pasteur, xx. (1906) p. 924.

‡ Tom. cit., p. 801.

§ Atti R. Accad. Lincei, xv. (1906) pp. 644-51 (2 figs.).

liquefaction of gelatin. It is motile and has 4 or 5 long flagella. Involution forms are frequent. Pure cultures when inoculated on previous healthy plants reproduce the disease.

CARBONE, D.—**Ricerche sull' Origine di alcuni pigmenti microbici con speciale riguardo allo Tironsinasi.** *Rend. R. Ist. Lombardo*, xxxix. (1906) pp. 327–58

GORINI, C.—**I Bacteri acido-presamigeni del latte in rapporto, all' igiene della mungitura.** *Tom. cit.*, pp. 236–42.

TREUTLEIN, A.—**Ueber chronische Oxalsäurevergiftung an Hühnern und deren Beziehung zur Aetiologie der Beriberi.** *Verhandl. Physikal. Med. Gesellsch. zu Würzburg*, xxxviii. (1906) pp. 323–45 (2 pls.).

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Swift's Students' Petrological Microscope.†—This Microscope (fig. 3) has recently been further improved from suggestions of J. S. Flett. The coarse-adjustment is by means of patented spiral rack-and-pinion, the slow focusing adjustment by a millimetre screw, the milled head of which is divided to read to $\frac{1}{100}$ mm. The glass-covered revolving stage has the edge divided to 360° reading to 5′ by means of a vernier. The polariser is fitted with divided flange and spring-catch to indicate the crossing of the Nicol prisms and is made to throw out of the optic axis when required; immediately above the polariser is fitted the convergent system of lenses. The analysing prism is fitted in a metal box which slides into the optical tube; below this is cut an opening for the introduction of a quartz wedge, undulation plate, or gypsum plate. Above the analysing prism is fitted a Bertrand lens with telescopic adjustment, by means of which the interference figures are perfectly shown in thick or thin crystals. The tube of the cross-webbed eye-piece is provided with an opening to allow of the use of a quartz wedge or micrometer.

Swift's University Binocular Microscope.‡ — This Microscope (fig. 4) is of medium height, and is designed to meet the requirements of the science student and of those who desire a binocular instrument for scientific recreation. The coarse-adjustment is effected by Swift and Son's patented spiral rack-and-pinion, and the slow movement by their Climax fine-adjustment. The stage, 4¼ in. by 3¾ in., will be found useful for systematically working over a slide. The right-hand corner of the main stage is divided into millimetres for the purpose of recording the position of the object for future reference. On the under side of the stage is a tube of the R.M.S. standard size for receiving apparatus.

Draper's Improved Magnifier.§—This magnifier (fig. 5) designed by D. Draper is intended for the examination of ores, rocks, and other solid bodies. By means of a concave reflector attached to the magnifier light can be concentrated on any portion of the object under examination, and

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Swift and Son's Catalogue, 1906, p. 21, fig. 17.

‡ Tom. cit., p. 11, fig. 8.

§ Tom. cit., p. 66, fig. 103.

Fig. 3.

Fig 4.

recesses in ores and rocks can be investigated without the interference of shadows. The combination used consists of a triple achromatic system giving an extremely large and flat field.

Fig. 5.

Fig. 6.

Swift's Dissecting Lens.*—This special dissecting lens (fig. 6) magnifies five times, and has a considerable working distance.

Beck's Hand Demonstration Microscope.—This instrument (fig. 7) is specially suitable for lecture classes and demonstrations with mounted specimens, and for examining unmounted specimens laid upon a table. The plate of vulcanite which forms the basis of the instrument has clips on both sides, the upper ones for holding a descriptive card, the lower ones for holding the specimen. The lens which magnifies about seven

Fig. 7.

diameters and has a large field, is mounted in a screw jacket which gives a large range of focusing motion. The lens-holder is mounted on three pillars forming an unusually strong construction, and enables the instrument to stand rough handling without damage.

Steinach's New Microscope Stand.†—This stand, which was planned by E. Steinach, and made by Carl Reichert, has now borne the test of a

* Swift and Son's Catalogue, 1906, p. 68, fig. 110.
† Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 308–12 (2 figs.).

year's trial. The designer's object was to contrive an apparatus which should possess the universal applicability and essential advantages of large, and correspondingly expensive Microscopes, without exceeding the cost of small cheap instruments. The ordinary rack-and-pinion movement was used for the coarse-adjustment; but for the fine-adjustment a simple solid slide-movement was constructed (fig. 8). The slide S is applied immediately behind the guide-piece of the coarse adjustment Z, and is pressed against the micrometer screw M by means of the spring F. The efficiency of the micrometer screw-action on the moveable part is secured by the point-contact between the micrometer screwtip and the hardened steel plate K, the result being a clean regular movement and the elimination of all dead-way in either forward or back screwing. The micrometer screw is set obliquely with regard to the guide-piece,

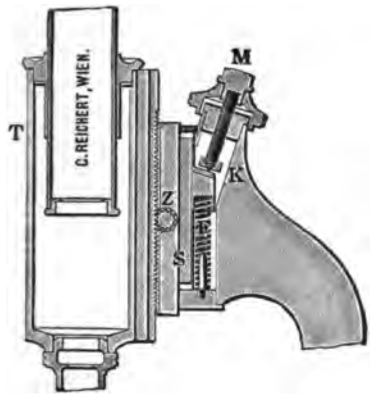

FIG. 8.

partly on account of the proximity of the slide-movement and coarse-adjustment, and partly to facilitate manipulation. This position does not prejudice in the least the delicacy and trustworthiness of the action. The whole arrangement is enclosed within the tube-holder, and thereby completely protected from dust. The large Zeiss * model (i^c) and Reichert's large new Microscopes have lateral micrometer screws, the essential advantage derived being that the upper part of the stand is independent of the fine adjustment mechanism, and can therefore be given a considerable projection. But owing to the complexity of the technical details, the method is costly, and only applicable to expensive Microscopes. The author points out that his simplified construction of the slide-movement accomplishes the same advantage at slight cost. The upper part of the limb projects considerably (fig. 9), and is shaped for a massive hook-like handle. The stage which can, therefore, be of large size, is prolonged into a broad continuation F reaching up to the handle: the median diameter is 125 mm. The extent of the heavy horseshoe foot is 143 mm. long by 113 mm. broad. The height of the

* Cf. Berger's Microscope, see this Journal, 1898, pp. 583–7.

instrument with drawn-out tube, after adjustment of nose-piece and objective, is about 36 cm.; the diameter of the test tube is 32 mm.

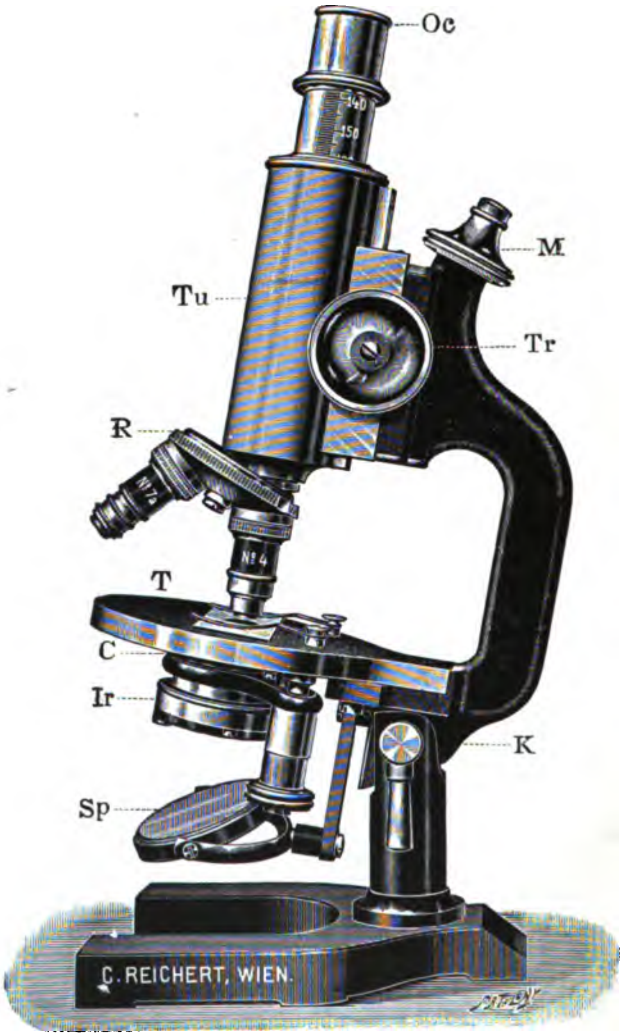

Fig. 9.

Dieck, W.—**Das Photomikroskop für ultraviolette Strahlen und seine Bedeutung für die histologische Untersuchung, insbesondere de Hartgewebe.**
SB. Ges. Natur. Freunde, Berlin, 1906.

Sabine, W. C.—**The Optical Advantages of the Ultra-violet Microscope.**
Journ. of Med. Research, xiv. (1906) p. 455.

SIEDENTOPF, H.—**Ueber ein neues physikalisch-chemisches Mikroskop (Mikroskopie bei hohen Temperaturen). 13. Hauptversamml. d. Bunsen-Ges. f. angew. physik. Chemie.** *Zeitschr. f. Elektrochemie*, xii. (1906) p. 593.

ZWINTZ, J., & O. THIEN—**Ueber einen neuen elektrisch-heizbaren Objekttisch für Mikroskope.** *Centralbl. Bakt.*, xlii. (1906) p. 179. See also *Zeitschr. wiss. Mikrosk.*, xxiii. (1906) p. 332.

(3) Illuminating and other Apparatus.

Siemens-Schuckert Projection Apparatus.*—The designs of the Siemens-Schuckert apparatus are intended to meet the projection requirements of all kinds of instruction and for audiences large or small. They

FIG. 10.

FIG. 11.

are suitable not only for Microscopic and physical demonstrations, but also for the exhibition of spectral and other optical phenomena. The most suitable light-source is the electric arc, both on account of its

FIG. 12.

FIG. 13.

simplicity as well as for its certainty. The lamp may be either the Siemens-Schuckert constant-current or variable-current lamp, fitted in a well-ventilated case which carries the optical equipment on its front wall. The lamps may be hand-regulated or automatic. The hand-regulated

* Siemens-Schuckert (Berlin), Special pamphlet, No. 23 (8906).

arc-lamp (figs. 10, 11) may be used, as desired, for constant current or for variable current, and has the further advantage that its current-strength

Fig. 14.

Fig. 15.

may be varied at pleasure by regulation of the resistance. The lamp is thus also useful for experimental purposes. In the projection of

Fig. 16.

Fig. 17.

diapositives the lamp is used in an inclined position, and for that purpose the upper carbon, in order to attain the optimum position of

illumination, has a movement of about 4 mm. towards the lens-opening, so that the incandescent crater of the upper carbon is formed towards the front. For spectral work the lamp is set upright and is therefore equipped with revolver carbon-holders which facilitate a quick readjustment of carbons when required. The automatic regulating lamps for constant current (fig. 12) and for variable current (fig. 13), are constructed on the differential principle and regulated for an assigned current-strength. In the choice of current-strength attention must be paid to the desired magnification as well as to the size of the audience room. In the use of good transparent diapositives of 8½ by 10 cm.,

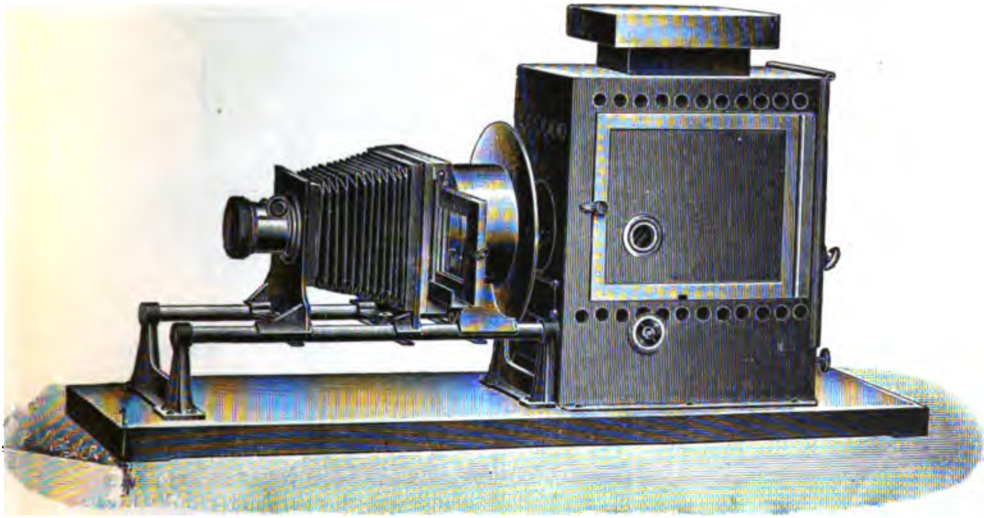

FIG. 18.

and of an image-size of 2–3 metres square at a projection distance of 5–8 metres a constant-current lamp usually requires a current-strength of 10–12 ampères; 8–10 metres projection distance requires 15–20 ampères; and greater distances 20–30 ampères. For a change-current double these strengths should be taken. To attain the most favourable light-values for projections with automatic constant-current lamps, the inclined position should be adopted and the carbons regulated as with the hand-lamp. For spectral work the perpendicular arrangement is required. The variable-current lamp is always set perpendicularly, the lower carbon, in projection work, being slightly advanced. A transformer of 50 volts secondary range is supplied with the variable-current lamp. Figs 14–17 show the lanterns for projection with the two kinds of current; fig. 14 showing the lantern open with hand-regulating lamp, figs. 15–17 an automatic-regulating lamp. The projection apparatus, with complete optical equipment consisting of optical bench, leather

bellows, condenser of 160 mm. diameter and diaphragm, objective of 200 mm. focus for diapositives up to 9 by 12 cm., are represented in figs. 18, 19.

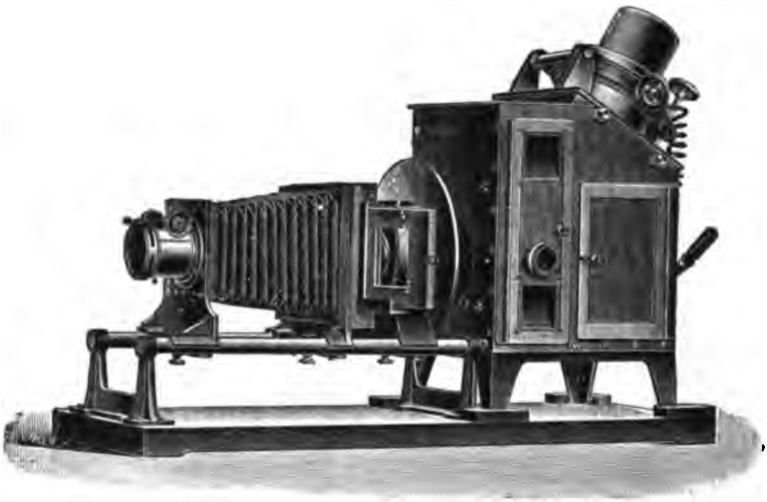

FIG. 19.

Stereoscopic Photo-micrographic Attachment for Monocular Microscopes.*—This apparatus (fig. 20), designed by Professor H. Jackson, allows of beautiful stereoscopic photographs to be taken with low powers such as 3 in., 2 in., and 1 in. objectives. It consists of a short fitting into which the object-glass is screwed, and contains an iris-diaphragm below which a slot is cut. Into the slot a strip of blackened metal slides, and this covers one half of the posterior combination of the objective. If, with the edge of the metal slide vertical, a negative be taken through one half of the lens, and another be taken after removing the slide and reinserting it so as to cover the other half of the back combination of the objective, these these two negatives will give prints yielding a stereoscopic effect such as is seen in a binocular Microscope. The iris-diaphragm is useful for lengthening the apparent depth of focus of the objective. Made by Swift and Son.

FIG. 20.

A New Slideholder.†—Under the name of Gleitlineal, C. Detto has designed a new form of slideholder. His attention was drawn to the matter by the difficulties of manipulating slides placed vertically in a projection Microscope. His apparatus consists essentially of a rotatory metal fork fastened on the rim of a circular stage of a Microscope. One

* Swift & Son's Catalogue, pp. 66, fig. 102.
† Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 301-7 (2 figs.).

prong of the fork (in a horizontal projection Microscope the lower one) takes the form of a straight bar; the other prong is a strong steel spring fitted with a metal roller. The object-slide is gripped firmly between the bar and roller, which glide compactly over the stage. The bar is bevelled inwards and the roller is slightly conical, so that slides of various thicknesses are always firmly pressed upon the stage. The apparatus has a vibratory movement about the attachment-point on the

FIG. 21.

stage-rim, which is clamped sufficiently tightly to prevent self-motion, but not so tight as to prevent push-action. The roller spring instead of being made of German silver is of good pliable steel, in order to adapt itself to any possible change of size in the slide. The apparatus has been designed in two forms, one for a strong circular stage (fig. 21), the other for a photo-micrographic stage (fig. 22). The first has a metal strip of same curvature as the stage, and carries at one end K a clamp fixed from underneath by a screw not visible in figure. The other end of this strip terminates in an arm above the stage and held fast to it by a screw similar to that used for the ordinary spring slideholder. In the photo-micrographic stage a different construction is necessary, because the stage here consists of two parallel plates. The peripheral strip now takes the

form of the complete circumference of the upper plate, but the ends terminate in perforated flanges clamped by a screw K; the remainder of the design is as before.

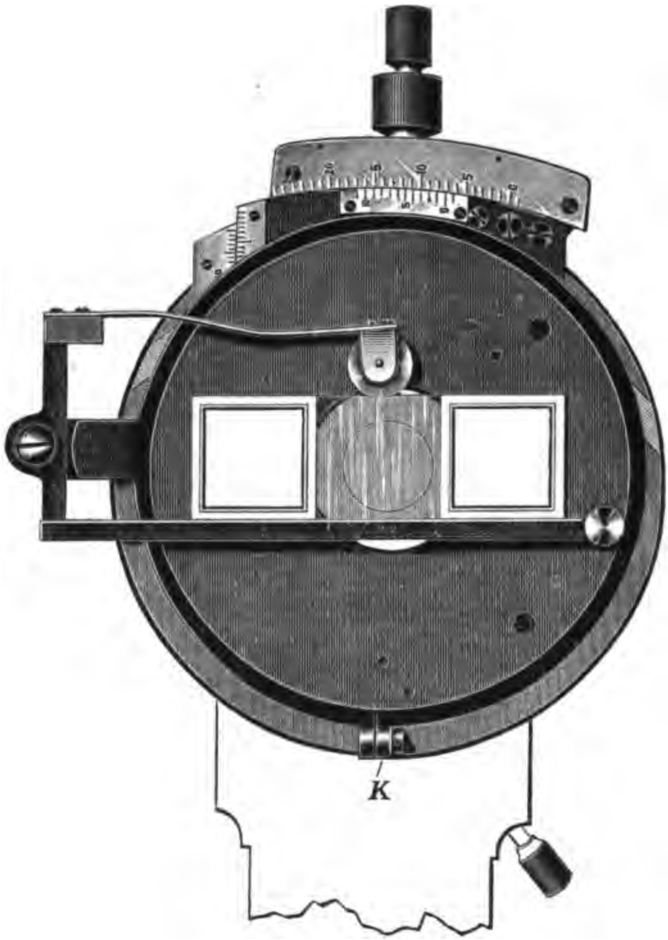

Fig. 22.

Application of the Nernst Incandescent Light to Biological Laboratories.‡—A. Greil, in his experiments to find the most suitable form of light-source for use with projection-drawing apparatus, obtained the best results with a special form of Nernst lamp. The usual three incandescent strands he rearranges in a six-pointed star, the ends of the rays being inserted in correspondingly formed bearers through which

* Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 257–86 (17 figs).

pass the platinum wires. The bearers are fastened on a circular porcelain plate, and are connected with four contact collars placed on the back of the plate; these collars being themselves connected with the same number of plugs inserted into a slate block and fitted with clamp screws. Means are provided for accurate centring of the light. The slate block, which is circular in form, bears on its circumference a flange which forms the rear wall of the diaphragm arrangement of the projection apparatus. Köhler's combination system of lenses for microprojection is used for the light concentration. This system yields the maximum light-intensity of the Nernst lamp. It consists of three lenses, the first of which, alone or in combination with two others, collects the light-rays. The condenser with a suitable condenser is available either for weak or for the highest magnifications. The lenses and lamp are mounted on a horizontal base board which acts as the optical bench, and is large enough to carry also the Microscope. Means are provided for raising or lowering the whole apparatus as required. A plane mirror, inclined at 45°, is fitted to the body tube of the Microscope, which is, of course, horizontal, and reflects the image on to the drawing-table at which the student sits. This table is adjustable in height, and this convenience added to the vertical adjustability of the optical bench gives considerable control over the distance between the Microscope and the table top. The arrangement has been found very convenient for photomicrography, the drawing apparatus being, of course, replaced by a camera; the uniform illumination afforded by the Nernst lamp specially lends itself to such work.

The author has found the Nernst lamp of the greatest service in the intensive illumination of small objects by incident light. This application is useful not only for photomicrography, but for many other purposes, e.g. the minute examination of manuscript, preparations of embryos, etc. He describes some 10 or 12 different forms of the lamp, the details being modified for special purposes.

(4) Photomicrography.

DEEGENER—**Der mikrophotographische Apparat von H. O. Juel.**
Natur. Zeitschr. Land. Forstw., iv. pp. 220–6.

EDER, J. M.—**Wichtigere Fortschritte auf dem Gebiete der Mikrophotographie und des Projektionswesens.** *Jahrbuch für Photographie und Reproduktionstechnik für das Jahr* 1906; and as a separate pamphlet (8 pp.), Halle (W. Knapp).

ERNST, H. E.—**Ultra-violet photomicrography.**
Journ. of Med. Research, xiv.(1906) pp. 463–9.

ERNST, H. E., & S. B. WOLBACH—**Ultra-violet Photomicrography.**
[A preliminary communication.] *Tom. cit.*, No. 3.

(5) Microscopical Optics and Manipulation.

Ultramicroscopes: Ultramicroscopic Objects.*—The above is a title of a work by A. Cotton and H. Mouton which deals with the present state of knowledge on this branch of Microscopy. It is written in a

* Les Ultramicroscopes: les Objets ultramicroscopiques. Paris: Masson et Cie., 232 pp., 17 figs.

very clear and vivid manner and seems a very complete presentation of the subject. The book is divided into nine chapters, the first three of which deal with the ultramicroscope and the others with ultramicroscopic objects. The first chapter discusses the limits of microscopic visibility, and the second explains how ultraviolet light bears upon the matter. The third chapter describes the ultramicroscope itself. The contents of the other chapters include the ultramicroscopic study of solids, liquids, Brownian movements, colloids, electric transport, and biological applications.

Study of the Rotation Impressed upon the Plane of Polarisation, by the Lenses of the Microscope under Convergent Light.*—G. Cesàro points out that Fresnel's formula for the passage of a polarised ray through a series of isotropic media readily lends itself to a very simple geometrical interpretation which renders it easy to construct the various paths of the ray. For this purpose it suffices to construct two planes:—(1) The plane containing the point of incidence and normal to the refracted ray; (2) the plane passing through the incident ray and its vibration. The intersection of these two planes gives the desired vibration. The same construction is continued from medium to medium. The author describes a number of experiments which illustrate his method.

Numerical Examination of the Optical Properties of Thin Metallic Plates.†—One of the first workers in this field was MacCullagh, who predicted from theory, and verified by experiment, that if light incident on a gold leaf were plane polarised, the transmitted beam would be elliptically polarised. With the improvement in experimental methods since MacCullagh's day, and the gradual removal of obscurities from the theory of metallic reflection and transmission, an almost exact numerical coincidence may now be looked for between theory and experiment. R. C. Maclaurin, in discussing the subject, points out that the condition of the reflected or transmitted beam is precisely described by means of two quantities—the ellipticity and the difference of phase between the components of the light polarised perpendicular to and parallel to the plane of incidence. The object of his paper is to obtain convenient formulæ for these quantities and to compare them with the results of experiments, selecting the most careful and the most recent that are available.

Colourless Lines produced by Convergent Light in Crystalline Laminæ.‡—G. Cesàro investigates the mathematical theory of the above, when the nicols are crossed at right angles. He starts from the usual equation for the intensity of a ray oblique to the crystalline laminæ and after passage through the analyser, viz.:—

$$I = a^2 \sin 2\alpha \sin 2\beta \sin^2 \pi \frac{R}{\lambda}$$

when α and β represent the angles, which one of the planes of vibration of the ray considered makes with the sections of the polariser and the

* Bull. de l'Acad. roy. de Belgique (Classe des Sciences) 1906, pp. 459–92.
† Proc. Roy. Soc., Series A, lxxviii. (1906) pp. 296–41 (24 figs.).
‡ Bull. de l'Acad roy. de Belgique (Classe des Sciences) 1906, pp. 368–99 (9 figs.).

analyser. The colourless lines are produced by the rays for which I vanishes independently of the value of the retardation R, i.e., by the rays for which either sin $2\alpha = 0$, or sin $2\beta = 0$; in other words by rays of which one of the planes of vibration is parallel to or perpendicular to the section of a nicol. The condition of parallelism is, however, impossible in a conical beam, and therefore the cone of rays giving the colourless line is the locus of rays of which one of the planes of vibration is perpendicular to the section of a nicol. The author follows up three modes of investigation and arrives at an equation (in general of the third degree) for the colourless cone; and at an equation (in general of the sixth degree) for the refracted cone.

In a later article * the author points out that the fundamental formula implicitly supposes that the vibration of the beam emergent from the polariser has not been deviated in traversing the lens which renders it convergent. This is not exact, both by reason of the deviation given by the glass to the vibrations oblique to the planes of incidence, and, *à priori*, by reason of the obliquity of the rays themselves. He therefore reconsiders the question on the basis that the horizontal deviation of a ray must be negligible. The colourless cone thus becomes the locus of directions of propagation, possessing a direction of vibration parallel to the section of a nicol. The author was somewhat surprised to find that he arrived at his previous equations, the explanation being that, if a direction of propagation possess a vibration parallel to the section of a nicol, the plane of vibration which corresponds to its other vibration is normal to the section of the same nicol.

LÖWE, F.—**Ein neuer Spektrograph für sichtbares und ultraviolettes Licht.**
[This is a description of Pulfrich's auto-collimation-spectroscope, made by C. Zeiss.] *Zeit. f. Instrumentenk.*, xxvi. (1906) pp. 330–3 (5 figs.).

(6) Miscellaneous.

Fluid Crystals.†—Under the title of "Are Crystals Alive," E. E. F. gives an account of a communication which was made by O. Lehmann at the last Congress of German Physicians and Physicists at Stuttgart.‡ It refers to some new and striking analogies between the development and characteristics of crystals and those of the lowest living organisms, and demonstrates the fact that no hard and fast line of demarcation can be drawn. This has been suspected by Haeckel for some time past. That ice-crystals imitate vegetable forms is known to every child. That they grow we all know. They have also a certain recuperative power, and they require a nucleus or germ to start their growth. They have, in addition, a power of absorbing foreign substances, as when salammoniac crystals absorb chloride of iron from a solution, and become darker than the solution itself. In the course of the process they "poison" themselves, and their growth becomes very irregular and imperfect.

But one essential difference remains. Animals are semifluid, or

* Bull de l'Acad. roy. de Belgique (Classe des Sciences) 1906, pp. 493–502 (1 fig.).
† English Mechanic, lxxxiv. (1906) p. 371. See also Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 377–9.
‡ Physikal. Zeitschr., Nov. 1, 1906.

partly so, whereas crystals are supposed to be essentially solid bodies. This supposition now no longer holds good, for Lehmann and some other chemists have succeeded in producing truly liquid crystals. Of these about fifty varieties have become known up to the present. The first kind discovered consisted of a modification of silver iodide which is stable above 146° C. It is viscous liquid, but under the microscope it reveals a distinctly crystalline structure. The most familiar example is soft soap, which consists of innumerable soft crystals. Some new chemical preparations with alarming names show this structure more strikingly. Vorländer's para-azo-oxy-benzoic-ethyl-ester is seen to consist of numerous crystals in constant motion. Whenever two crystals collide they coalesce with a jerk, just like drops of liquid. Another substance exhibits soft crystals in long straight columns with sharp facets. Gattermann's para-azoxy-phenetol is as liquid as water, and occurs in drops; but each drop possesses a structure which is easily proved to be of a crystalline character. Seen in the direction of the axis of symmetry, each drop appears to have a round nucleus; but seen in a direction normal to this axis, the nucleus appears like a bi-convex lens. Both these structures are unreal. They are products of refraction. But they prove that the drops are not isotropic. When two drops collide they form one drop; but the new drop has two nuclei, with a third between them, and this lasts for several minutes. In polarised light the drops show well-marked dichroism, and between crossed nicols they show beautiful interference colours, just like solid crystals. On squeezing or bending such a liquid crystal and releasing it, it resumes its original shape after a short time, just as an amœba would do. Two species of crystals may be "crossed." Thus, two varieties of cholester-ethyl-caprinate may be combined in a structure recalling the lustre of a butterfly's wings. These phenomena, striking as they are, do not exhaust the wonders of liquid crystals. Vorländer has observed exceedingly curious phenomena in a substance called para-azoxy-cinnamo-ethyl-ester. Under suitable conditions, the crystals take the shape of spheres flattened on one side. When two such drops meet three different things may happen. Either the drops are in the same position—say with both bases downward, and one on top of the other; then they coalesce into one round drop. Or the bases touch; then they form a twin or couple without running together. When they meet in any other way they form a drop with two flat surfaces. The "copulation" of two individuals has a remarkable counterpart in the process of "budding," which is sometimes observed, small buds appearing on the flat surfaces, and dropping off when they reach a certain size. Further, the drops often make a chain resembling a bacterium, growing by intussusception instead of by apposition. These rods may be spirals, and are often seen in serpentine motion. Eventually they break up, and each fragment develops into a perfect individual. These curious experiments, which were exhibited at the Congress, made it practically impossible to assign a definite limit to vital phenomena, or to say where organic matter ends and inorganic matter begins.

Quekett Microscopical Club.—At the 434th Ordinary Meeting of the Club, held on November 16, 1906, Mr. F. P. Smith communicated

a paper on "The British Spiders of the genus *Lycosa*." Mr. F. P. Smith delivered a lecture on "Vagabond Spiders." He said that by "vagabond" he meant "wandering," and included in the term all those spiders which did not make snares. The three principal groups of "vagabonds" were represented by the families Lycosidæ, Thomisidæ, and Salticidæ, and their characteristics were described at some length.

At the 435th Ordinary Meeting, held on December 21, 1906, Mr. W. R. Traviss exhibited and described an expanding central stop for obtaining dark-ground illumination. A "Note on New Diatom Structure," by Mr. A. C. Eliot Marlin, F.R.M.S., was read. This dealt with "veiled" markings recently noted on certain species of *Melosira* and *Hyalodiscus*, and on a *Navicula* and *Aulodiscus*. Details of apparatus employed and illumination used were given. An interesting discussion followed.

BEHN, N., & W. HEUSE—**Zur Demonstration der Abbeschen Theorie des Mikroskops.** *Verh. d. Phys. Ges.*, viii. (1906) pp. 283–9.

DAY, A. L., & E. S. SHEPHERD—**Quarzglas.** *Deutsch. Mechan. Zeit.*, 1906, p. 137. See also *Science*, xxiii. (1906) p. 670.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Artificial Cultivation of Spirochæta pallida.†—A. Fontana removed small portions of tissue from primary sores and soft papillæ, and introduced them into various fluid media—sterile human blood, human blood with citrate of sodium solution, blood serum, ascitic fluid, etc.; most of the tubes became overgrown with contaminating organisms by the fortieth day, but in no case was there any cultural development of spirochætes. But examination of the portions of tissue showed that the spirochætes were still present, having withstood the action of the other organisms; and those portions that were kept at 37° C. from 8–30 days showed a great increase in the number of the spirochætes; and this was especially the case when the portions of tissue were brought into ascitic fluid and into gelatin with ascitic fluid and incubated at 37° C.

By placing portions of skin or mucous membrane from non-syphilitic individuals in the test glasses, together with portions of syphilitic tissue, the authors demonstrated in several cases the transference of spirochætes from the diseased into the healthy tissue.

Direct Impression on Photographic Paper to Replace Drawings by Hand.‡—M. Yegounow by the use of Velox paper obtains good shadow images, for which he details many obvious uses and advantages over drawings made by hand, especially in representing cultures on Petri dishes, ascertaining the contours of small objects, and acquiring measurements of colonies.

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.

† Centralbl. Bakt., 1te Abt. Orig. xlii. (1906) p. 666.

‡ Op. cit., 2te Abt. xvii. (1906) p. 412.

Lemco Litmus Broth.*—M. H. Gordon, in an investigation of the biochemical characters of *Staphylococcus epidermidis albus*, used the following medium as a test for acid production. The medium is of constant composition, but by the addition or omission of certain ingredients may be found suitable for other purposes. The chief advantage is the substitution of lemco for beef broth. Lemco 1 p.c., pepton 1 p.c., sodium bicarbonate 0·1 p.c., carbohydrate or polyatomic alcohol 1 p.c., 10 c.cm. per cent. aqueous solution of ordinary solid litmus, and 1 p.c. maltose.

VIGUIER, C.—**Nouvel Appareil pour la Recherche et la Récolte rapide du Plankton.** *Archiv. Zool. Expér et gén., Notes et Revue*, v. (1906) pp. xlix.–lviii (6 figs.).

(2) Preparing Objects.

Examining the Thymus of Birds.†—C. Ciaccio fixed the thymus of fowls and pigeons in Bouin's fluid (formol-picro-acetic acid) and in Ciaccio's mixture (formol-chromo-acetic acid). The sections were stained with—(1) Heidenhain's iron-hæmatoxylin; (2) Apáthy's hæmatein I A, or Mayer's hæmalum—both these stains were followed by eosin or picro-fuchsin; (3) eosin and thionin or toluidin-blue.

Studying the Spermatogenesis of Pyrrhocoris apterus.‡—J. Gross examined both the larvæ and imagines of *Pyrrhocoris apterus*, collected at various times of the year. The fixatives used were Flemming's mixture and vom Rath's fluid, with and without osmic acid. The sections were stained with iron-hæmatoxylin, and occasionally counterstained with eosin. As controls to the iron-hæmatoxylin, alum-carmine and bleu-de-Lyon and Flemming's triple stain were used. The sections were from 7·5–5 μ.

Fixing and Staining the Œnocytes of Torymus nigricornis.§—R. Weissenberg first benumbed the animals with chloroform, and then immersed them for about 45 seconds in water at about 75°. The cuticula was then ruptured with a needle or scissors, after which the animal was immersed in Carnoy's alcohol-chloroform-acetic acid fluid, or in Petrunkewitsch's modification of Gilson's mixture. Heat, however, was employed in connection with the latter fixative. Staining was effected with Delafield's hæmatoxylin. It was found better to overstain and decolorise with acid-alcohol, and differentiate with ammonia or lithium carbonate.

Fresh preparations were examined in physiological salt solution, or in the juices of the animal itself. For sectioning, the mastix-collodion method was used.

Studying the Larvæ of the Dragon-Fly.‖—Caroline McGill, when studying the behaviour of the nucleoli during oogenesis of the dragon-

* Rep. Local Gov. Board, 1906, Appendix B, pp. 388–9.
† Anat. Anzeig., xxix. (1906) pp. 597–600 (3 figs.).
‡ Zool. Jahrb., xxiii. (1906) pp. 269–336 (2 pls.).
§ Tom. cit., pp. 231–68 (1 pl.).
‖ Tom. cit., pp. 207–30 (5 pls.).

fly, with especial reference to synapsis, used the larvæ of *Anax junius* and *Plathemis lydia*. Fresh and preserved material was employed. Fresh material was examined in salt solution; in this condition all the details can be clearly demonstrated, as in the fixed and stained egg-strings. For the finer details, sections were necessary, the material being fixed in Flemming's or Gilson's fluid. The abdomens of the larvæ were opened while submerged in the salt solution; the ovaries were clipped off with fine scissors, and transferred promptly to the fixative. The stains used were Heidenhain's iron-hæmatoxylin, Flemming's triple stain, and the borax-carmin-methyl-green method of Obst.

Demonstrating the Elastic Tissue of the Eye of Birds.*—E. W. Carlier bisected the eyes into anterior and posterior halves, and after removal of lens and vitreous humour the anterior halves were placed in picro-corrosive formalin mixture (Mann). When thoroughly fixed, they were passed through upgraded alcohols, to benzol, benzol and paraffin, and finally pure paraffin. Radial sections, including all the coats of the eye-ball, were then made through the sclero-corneal junction, and after removal of the paraffin were stained with Weigert's elastic stain and mounted in balsam.

(3) Cutting, including Imbedding and Microtomes.

Photoxylin as an Imbedding Medium.†—Bindo de Vecchi finds that photoxylin dissolved in methylic alcohol forms an excellent imbedding medium and is superior to celloidin. The procedure is as follows: (1) Immersion of the piece in absolute methylic alcohol for 24 hours; (2) Immersion in 1 p.c. methylic-photoxylin for from 24 hours to several days; (3) Immersion in 5 p.c. methylic-photoxylin for similar period; (4) Exposure under glass bell jar for short time, to allow evaporation of alcohol; (5) Trimming of the block and fixing to piece of wood with thick gelatin solution; (6) Exposure to air for about an hour; (7) Immersion in 85°–90° alcohol until quite hard.

Sticking Paraffin Sections on the Slide.‡—K. Helly disseminates a device which he says never fails to cause the section to adhere by the water method. It consists in passing the perfectly cleaned slide two or three times through the flame from a Bunsen burner just before depositing the section.

Gelatin-formalin Method of Sticking Microscopic Sections to the Slide.—Olt § makes his adhesive of 10 grm. gelatin which is dissolved in 100 c.cm. of water. The white of one egg is added to the mixture filtered. To the filtrate 10 c.cm. of 5 p.c. phenol is added. A small piece is liquefied on the blade of a knife and rubbed over the surface of a slide. Celloidin sections are then placed on the slide, and are mopped up and at the same time flattened out by means of blotting paper. A strip of thin paper dipped in 10 p.c. formalin is placed over the section, and another slide on the top. In a few seconds the celloidin sections

* Proc. Scot. Micr. Soc., iv. (1906) pp. 70–92 (4 pls.).
† Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 312–15. ‡ Tom. cit., pp. 330–1.
§ Tom. cit., pp. 323–8.

will have adhered to the underlay. Should special care be demanded the section may be placed for a few minutes in 10 p.c. formalin, or exposed to action of formalin vapour in a closed vessel.

The further treatment of the sections is the ordinary one: there is no fear that the sections will fail to adhere. Paraffin sections are treated in a very similar way. Frozen sections are also amenable to this fixation method. The sections are taken off the knife and transferred to a solution of the gelatin and water (1–10), and then placed on a slide. The preparations are then exposed to the action of formalin vapour in a closed vessel. After at least one hour the preparations are immersed in 10 p.c. formalin. The subsequent treatment is the usual for frozen sections.

Similar devices have been suggested by Koninski* and by Bolton and Harris.†

(4) Staining and Injecting.

Staining Bacteria in Sections.‡—Saathoff advises the following method for staining bacteria in sections, whereby, in a blue and reddish stained tissue, the organisms are stained deep red, nuclear membrane and network appear blue, nuclear granules and protoplasm red. Methyl green 0·15, pyronin 0·5, 96 p.c. alcohol 5·0, glycerin 20, and 2 p.c. carbolic acid water to 100. Stain for 2–4 minutes, wash with tap water until the green colour changes to bluish red, wash in absolute alcohol, clear for few seconds in xylol, and mount in balsam.

Carmin Staining of Glycogen and Nuclei.§—F. Best used celloidin sections, and did not remove the imbedding medium, as this prevented the glycogen from being dissolved out in water. The staining solution was composed of: carmin 2, potassium carbonate 1, calcium chloride 5. These ingredients were boiled in 60 of water for some minutes, and when cold 20 of liq. ammon. caust. were added. The solution must be filtered before use.

For staining, the procedure was as follows. Stain with Böhmer's hæmatoxylin or hæmalum, and differentiate with hydrochloric acid alcohol. Then immerse the sections for 5 minutes in a mixture composed of 2 parts of the carmin solution, 3 of liq. ammon. caust., and 3 of methyl-alcohol. Differentiate in absolute alcohol 80, methyl-alcohol 40, distilled water 100. Dehydrate in alcohol, and mount in balsam. For staining nuclei, almost any preparation of carmin is more or less useful, but the following mixture is effective: carmin 2, ammon. chlorat. 4, lithium carbonicum 1, distilled water 100. Boil, and when cold add liq. ammon. caust. 20. Keep in stoppered bottle, and add some thymol to prevent mouldiness.

RÖTHIG, P.—**Wechselbeziehung zwischen metachromatischer Kern- und Protoplasmafärbung der Ganglienzelle und dem Wassengehalt alkoholischer Hæmatoxylin lösungen.**

[Remarks on the difference of colour in nuclei after treatment with hæmatoxylin solution variously diluted with water.]

Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 316–18.

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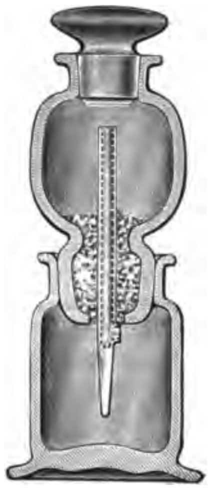
* See this Journal, 1898, p. 686. † Op. cit., 1903, p. 768.

‡ Centralbl. Bakt., Ref., xxxviii. (1906) p. 777.

§ Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 319–22.

(5) Mounting, including Slides, Preservative Fluids, &c.

Filter Bottle for Mounting Fluids.—H. Taverner exhibited at the November Meeting, 1906, a small filter bottle (fig. 23), the special advantage of which is that volatile micro-mounting fluids can be filtered with or without heat, and without alteration in strength, as any vapour that may be given off is retained in the bottle. The apparatus consists of a bottle-shaped funnel which fits like a stopper into the neck of the lower bottle. In this funnel-stopper a tube is placed, and the surrounding space firmly packed with cotton or glass wool. The fluid to be filtered is placed in the upper bottle, care being taken that it does not reach the top of the tube, which is for the purpose of allowing the air or vapour to pass from the lower to the upper bottle during filtration. The filter has been used for glycerin jelly, glycerin solutions, celluloid varnish, celloidin, benzol, balsam, etc.



Half actual size.

FIG. 23.

(6) Miscellaneous.

Method for Differentiating Bloods.*—Piorkowski, following on his observations that ox serum causes a coagulum with cow's milk, but with woman's milk has no reaction, finds that when hydrocele fluid, ascitic fluid, or human serum, is treated with human blood, after half an hour a red deposit occurs, a clot forms and the supernatant fluid remains clear; other varieties of blood are dissolved in the human fluid. Using the sera of horses, cattle, and other animals, it was found that homologous bloods were coagulated, heterogenous bloods were dissolved.

Improved Methods for Recognition of Blood and Seminal Stains.†
E. H. Hankin has found that if a blood stain has been altered by putrefaction or drying it may, nevertheless, give the absorption bands of hæmochromogen, even although the blood-colouring matter is in an apparently undissolved and insoluble condition. The suspected stain is cut out and plunged into boiling water for a few moments. It is then placed on a slide and wetted with ammonium sulphide. It is examined under the microscope and the specimen is moved until the whole field of view is occupied by a portion of the coloured material. If this cannot be achieved with a low power the use of an oil immersion may be necessary. The eye-piece is then taken out and replaced by a microspectroscope. If the stain is of blood the two absorption bands of hæmochromogen will be seen. Should the bands not be visible, as may occur apparently owing to the effects of putrefaction, a drop of 10 p.c. solution of potassium cyanide should be allowed to fall on the stain. Two bands will at once develop resembling those of hæmochromogen, but situated a little nearer to the red end of the spectrum.

* Centralbl. Bakt., Ref., xxxviii. (1906) p. 752.
† Brit. Med. Journ. (1906) ii., pp. 1261 and 1843.

If the stain be on a weapon or piece of jewellery, it should first be wetted with ammonium sulphide. A small portion may then be scraped off with a knife and treated as above.

In dealing with seminal stains the suspected stain is boiled for 2 minutes in an aqueous solution containing tannin ½ p.c. and sulphuric acid 1 per thousand. It is then washed for 2 minutes in a solution made by adding 1 part of saturated ammonia solution to 400 of water. This is followed by immersion for 5 minutes in a solution containing 1 in 10,000 potassium bichromate and 1 in 1000 sulphuric acid. Next it is transferred for 2 minutes to a 2 p.c. solution of potassium cyanide. It is then rapidly washed in distilled water, scraped, and teased up on a slide, dried, fixed by heat, and stained.

Swift's Slitting and Polishing Machine for Rocks.*—This apparatus (fig. 24) is practically self-acting when once the material to be cut has been

FIG. 24.

placed in position. It is then only necessary to turn the handle, which carries either the slitter or the polishing lap. The apparatus works at considerable speed, which is effected by multiplying-gear fitted to the vertical shaft to which the handle is fixed. The ordinary gut-band is superseded by a fine endless chain, which is geared in such a way that it cannot be deranged. A fine-adjustment is fitted to the clamp which holds the sections, so that a specimen can be cut to any given thickness, thus enabling the sections to be cut so thin that they require little or no reducing upon the lap. The size of the apparatus is 24 in. by 12½ in.

Metallography, etc.

Liquid Crystals of Ammonium oleate.†—F. Wallerant describes the peculiar optical properties of a layer of ammonium oleate compressed between a slide and a cover-glass. Under the influence of vibration portions of the turbid layer become transparent, then possessing a definite crystalline orientation. Ammonium oleate may exist in four polymorphic modifications.

The Internal Architecture of Metals.‡—A report of a popular lecture by J. O. Arnold at the Royal Institution. Some metallographic

* Swift and Son's Catalogue, 1906, p. 28, fig. 26.
† Comptes Rendus, cxliii. (1906) pp. 694–5 (1 fig.).
‡ Nature, lxxv. (1906) pp. 43–5 (3 figs.).

questions were dealt with in an elementary manner. The formation of a eutectic network by the addition of a small percentage of bismuth to gold, the electrolytic decay of brass resulting in dezincification, the structure of steel, and the failure of steel by fatigue, were among the subjects touched upon by the lecturer.

Crystallisation of Minerals.*—T. M. Lowry discusses Day and Shepherd's study of the crystallisation of the lime-silica series. Among the many difficulties which surround the determination of melting points of minerals are the excessively high temperatures and the slowness with which many minerals attain equilibrium on change of temperature. The employment of the radiation pyrometer, and of iridium vessels (melting point at least 600° C. above that of platinum), has rendered possible accurate work at very high temperatures. The equilibrium diagram given indicates the formation of two definite compounds ($CaSiO_3$ and Ca_2SiO_4) and three eutectics. Silica, and the two compounds, are polymorphous.

Practical Applications of Microscopic Metallography in Works.† In this paper, read at the Brussels Congress of the International Association for Testing Materials, H. le Chatelier gives a comprehensive and somewhat lengthy review of the subject. The paper is divided into sections as follows: (1) Examples of practical application—three striking instances are given. (2) Information furnished by microscopic examination, bearing on (*a*) chemical composition, (*b*) structure, (*c*) deformations. (3) Ways in which metallography may be employed in works, (*a*) for the regular control of manufacturing operations, (*b*) for research with a particular object in view, (*c*) for research of a more indirect and general nature. (4) Particular industries in which metallography is of value. (5) Cost of metallography. Numerous examples are given, fully illustrated by photo-micrographs.

Quenching of Steel.‡—P. Lejeune describes a method of studying the rate of cooling of large pieces of steel in quenching. The Saladin method of recording differences of temperature is used. Two thermo-couples are inserted in the sample (a cylinder 5 cm. by 5 cm.), the junction of one being at the centre, that of the other midway between centre and surface. By means of suitable connections of these couples to galvanometers, the actual temperature of the centre, and the difference of temperature between the two points are recorded. A resistance furnace with carbon as the resistor was used for heating the samples. The author gives some curves he has obtained.

Some Obscure Points in the Theory of Cementation.§—Partiot indicates the wide range of application of case-hardening, and suggests that researches on the following lines will give results of practical value: (1) Determination of the laws giving the depth of penetration as a function of time and temperature; (2) study of cementing media and "anti-cements" (substances which prevent or retard cementation); (3)

* Nature, lxxv. (1906), pp. 112–3 (1 fig.). See also Journ. Amer. Chem. Soc., xxviii. (1906) pp. 1089–1114.
† Rev. Métallurgie, iii. (1906) pp. 493–517 (36 figs.).
‡ Tom. cit., pp. 528–34 (8 figs.).
§ Tom. cit., pp. 535–40.

study of the causes of crystallisation causing brittleness, developed by cementation; (4) study of deformation caused by cementation, appearing either after that operation or after the subsequent quenching.

The Composition of the Eutectic Copper-Copper Oxide.*—E. Heyn defends the accuracy of his statement that the eutectic contains 3·5 p.c. oxide. With 5 p.c. oxide (the eutectic composition given by Dejean) the alloy is clearly hyper-eutectic. This is shown by the distinct segregation of a 5 p.c. alloy—a pure eutectic shows no segregation. The author suggests that Dejean's high results are due to faulty sampling of the ingots for analysis.

Fournel's Researches and the Lower Limit of A 2.†—F. Osmond, remarking on the difficulty of determining the temperature at which, on cooling, the magnetic transformation of iron ends, indicates the bearing of Fournel's results (embodied in two papers here given in full) on the question. Fournel determined the critical points by measuring electrical resistance throughout the range of temperature. Osmond considers that, in the curves showing relation between resistance and temperature, the point at which the curve ceases to be a straight line marks the lower limit of the range A 2. This temperature varied from 350° C.–100° C. in the steels used in Fournel's investigations. Osmond gives a diagram showing the proportions of the α, β and γ modifications contained in iron at different temperatures.

Nickel-Silicon Steels.‡—A further instalment of L. Guillet's work on quaternary steels. Forty-nine alloys, prepared to show the effect of increasing amounts of silicon on the three classes of nickel steels (pearlitic, martensitic and γ-iron) were subjected to exhaustive microscopic examination and were tested mechanically. The results appear to agree substantially with the deductions drawn from the author's researches on nickel steels and silicon steels, subject to the following modifications. (1) The addition of silicon tends (*a*) to hinder the formation of martensite; (*b*) to cause a γ-iron nickel steel near the border of the martensitic class to become martensitic; (*c*) to increase the maximum stress and elastic limit, and diminish elongation and resistance to shock, of pearlitic steels. Size of grain is diminished; (*d*) to improve the mechanical qualities of γ-iron steels by raising the maximum stress; (*e*) to raise the position of the thermal critical points. (2) The presence of nickel tends (*a*) to counteract the effect of silicon in causing graphite separation, both in the original condition and after annealing at 900° C.; (*b*) to cause graphite to be more readily separated in high carbon than in low carbon steels. White areas visible in γ-iron steels of sufficiently high silicon content appear to be a silicide of iron or nickel. Some of the steels containing large amounts of nickel and silicon show extraordinarily complex micro structures. The addition of more than 2 p.c. silicon to nickel steels does not appear to offer any advantages.

Etching Reagents for Steel.§—Kourbatoff states that failures met with in using one of his etching solutions have been due to the employ-

* Rev. Métallurgie, iii. (1906) pp. 543–4.
† Tom. cit., pp. 551–7 (3 figs.). See also this Journal, 1905, p. 516.
‡ Tom. cit., pp. 558–77 (19 figs.).
§ Tom. cit., p. 648. See also this Journal, 1905, p. 392, and 1906, p. 635.

ment of acetic acid instead of acetic anhydride in its preparation. He gives the exact mode of making up the reagent, as follows. Two separate solutions are prepared. (1) 4 p.c. of nitric acid in acetic anhydride; (2) A mixture in equal parts of the three alcohols, methyl, ethyl, and iso-amyl. Immediately before use, 1 part of (1) is added to 3 parts of (2).

The Brinell Method of Hardness Measurement at the Brussels Congress.*—The papers read at Brussels on this method of testing, now assuming considerable importance, are summarised by H. le Chatelier: (1) Influence of variation in diameter of ball, and in pressure. If H is the hardness number obtained under the standard conditions (ball 10 mm. diameter, pressure 3000 kg.), H dp the hardness number given with ball diameter d and pressure p, then—

$$H = H\,dp \sqrt[5]{\frac{d}{10}} \cdot \frac{20{,}000}{17{,}000 + p}$$

(2) Degree of accuracy obtainable—the error should not exceed 0·5 p.c.; (3) Relation between hardness number and maximum tensile stress. This important point is fully considered. For nearly all classes of steel the tenacity may be calculated within 5 p.c. by multiplying the hardness number by a coefficient depending on the kind of steel. The coefficients given by different workers and for different material vary from 0·344 to 0·376; (4) Hardness tests by impact, and the possibility of substituting hardness for tensile tests, are considered.

Alloys of Zinc and Iron.†—S. Wologdine prepared alloys containing up to 9·5 p.c. iron by dissolving iron in molten zinc. By heating an alloy containing 8·5 p.c. iron at 1000° C., a residue with 42 p.c. iron was obtained. The etching reagents giving the best results for microscopic examination were a 5 p.c. solution of iodine in absolute alcohol, and a lead chloride solution. With 0·07 p.c. iron well marked crystals of a hard constituent were detected. With 8 p.c. iron the alloy consisted wholly of this crystalline constituent. By dissolving out the excess of zinc in a 7·1 p.c. alloy with lead chloride solution the constituent was isolated and found to contain 8·14 p.c. iron. It appears to be $FeZn_{10}$. A freezing point curve is given for the system for the range 0 to 12 p.c. iron, showing a maximum at 8 p.c. of 750° C. The melting point of zinc appears to be raised by smallest additions of iron. Zinc and the compound $FeZn_{10}$ do not give solid solutions.

Constitution of Hardened and Tempered Tool Steels.‡—E. Heyn and O. Bauer, investigating the nature of troostite and sorbite, quenched small pieces of a eutectoid steel (carbon 0·95 p.c.) at 900° C. These were then heated at different temperatures and for various lengths of time and again quenched. The hardness of each piece was measured by the Martens sclerometer, and the rate of solution in dilute sulphuric acid determined. The carbon condition was determined by dissolving in 10 p.c. sulphuric acid in absence of air, and estimating carbon

* Rev. Métallurgie, iii. (1906) pp. 689–700.
† Tom. cit., pp. 701–8 (7 figs.).
‡ Stahl und Eisen, xxvi. (1906) pp. 778–84, 915–22, 991–7 (49 figs.).

(1) escaping as gas (hardening carbon), (2) left as carbide, (3) left as free carbon, denoted by Heyn as Cf. The maximum amount of carbon existing in this state was found in the sample heated at 400° C. The authors' main conclusions are:—(1) The transformation of martensite into pearlite by letting down a hardened steel is not continuous; a definite, well characterised intermediate phase is passed through. The name "Osmondite" is proposed for this constituent. (2) Osmondite has the highest solubility in dilute sulphuric acid. On solution in sulphuric acid it gives the highest yield of free carbon. (3) On etching with alcoholic acids, osmondite gives the darkest colour, as it is the separation of this free carbon which colours the sample. (4) Quenching, rapid or slow, is equivalent to perfect supercooling to pure martensite, followed by more or less tempering. The extent of the letting down depends on the rate of cooling. According to the authors, the order of transition is martensite, troostite, osmondite, sorbite, pearlite.

F. Osmond discusses this paper.* He suggests that the iron of osmondite may be identical with Beilby's hard phase. He considers that the properties of quenched steel may be due to all of the three following causes:—(1) Retention of the carbon in the state of hardening carbon; (2) partial retention of the iron in an allotropic modification; (3) hardening by deformation caused by change in volume. Osmond then gives definitions of the constituents of steel, having regard to Heyn's results.

The original papers should be consulted for a complete account of the experiments leading to the remarkable conclusions here outlined.

Iron-Carbon Alloys.†—P. Goerens discusses the equilibrium diagram of the iron-carbon system, corrected by Roozeboom from the results of Carpenter and Keeling. Heyn's view that all iron-carbon alloys tend to decompose finally into iron and carbon, and that the presence of cementite is due to supercooling, is supported by the author's experiments on three alloys, A, B and C. They were prepared from Swedish iron and sugar-carbon, A contained 3·95, B 4·5, C 4·8 p.c. carbon. They were cast in thick-walled iron moulds, to give rapid solidification and cooling. Microscopic examination showed that A was martensite-cementite eutectic plus a little excess martensite, B was practically pure eutectic, C was eutectic plus a little excess cementite. In molten solutions the carbon exists as carbide. A 4·7 p.c. alloy was cooled in a manner to give incipient graphite formation. It consisted of martensite-cementite eutectic with areas of excess martensite through which ran veins of graphite. The author elaborates a theory, according to which cementite is formed on solidification, decomposing, if sufficient time at a high temperature be allowed, yielding graphite. Remarkably clear photomicrographs support the author's conclusions.

CLARAGE, E. T.—**The Manufacture of Tool Steel.**
English Mechanic, lxxxiv. (1906) pp. 372–4.

DOERINCKEL, F.—**Alloys of Thallium with Copper and Aluminium.**
Zeitschr. Anorg. Chem., xlviii. (1906) pp. 185–90 (2 figs.).

* Rev. Métallurgie, iii. (1906) pp. 621–32 (7 figs.).
† Tom. cit., pp. 175–86 (15 figs.).

DUJARDIN, P. F.—**Technique of Metallography.**
Stahl und Eisen, xxvi. 1 (1906), pp. 522–8, and pp. 732–5 (8 figs.).

FRIEDRICH, K.—**Segregation.** *Metallurgie*, iii. (1906) pp. 13–25 (9 figs.).

„ „ **Lead and Arsenic.** *Tom. cit.*, pp. 41–52 (15 figs.).

„ „ **Lead and Silver.** *Tom. cit.*, pp. 396–406 (22 figs.).

FRIEDRICH, K., & A. LEROUX—**Silver and Arsenic.**
Tom. cit., pp. 192–5 (7 figs.).

„ „ **Silver and Silver Sulphide.**
Tom. cit., pp. 361–71 (24 figs.).

„ „ **Zinc and Arsenic.**
Tom. cit., pp. 477–9 (7 figs.).

GOERENS, P.—**Constitution of Cast Iron.**
Stahl und Eisen, xxvi. 1 (1906), pp. 397–400 (12 figs.).

HEYN, E.—**Notes on Metallographical Practice.** *Tom. cit.*, pp. 8–16 (28 figs.).

„ **Application of Metallography in the Iron Industry.**
Tom. cit., pp. 580–96 (51 figs.).

„ **Metallographical Research in Foundry Practice.**
Tom. cit., pp. 1295–1301 (4 figs.).

HEYN, E., & O. BAUER—**Copper and Sulphur.**
Metallurgie, iii. (1906) pp. 73–86 (26 figs.).

LEDEBUR, A.—**Notes on Cementation.**
Stahl und Eisen, xxvi. 1 (1906), pp. 72–5 (1 fig.).

MATHEWSON, C. H.—**Sodium-Aluminium, Sodium-Magnesium, and Sodium-Zinc Alloys.** *Zeitschr. Anorg. Chem.*, xlviii. (1906) pp. 191–200 (3 figs.).

PETRENKO, G. I.—**Silver-Zinc Alloys.** *Tom. cit.*, pp. 347–63 (10 figs.).

PFEIFFER, V. O.—**Alloying Capacity of Copper with Pure Iron and Iron-Carbon Alloys.** *Metallurgie*, iii. (1906) pp. 281–7.

PÜTZ, P.—**Influence of Vanadium on Iron and Steel.**
Tom. cit., pp. 635–8, 649–56, 677–86 (6 figs.).

ROGERS, F.—**Some Microscopic Strain Effects in Metals.**
Tom. cit., p. 518–27 (2 figs.).

TAMMANN, G.—**Aluminium-Antimony Alloys.**
Zeitschr. Anorg. Chem., xlviii. (1906) pp. 53-60 (2 figs.).

HOITSEMA, C., & W. J. VAN HETEREN—**Metallography as an Aid in the Detection of False Coins.**
Metallurgie, iii. (1906) pp. 128–30 (11 figs.).

WÜST, F.—**Iron-Carbon Alloys of High Carbon Content.**
Tom. cit., p. 1–13 (27 figs.).

„ **Influence of Foreign Elements on Graphite Separation in Cast Iron.**
Tom. cit., pp. 169–75, 201–5 (3 figs.).

VOGEL, R.—**Gold-Zinc Alloys.**
Zeitschr. Anorg. Chem., xlviii. (1906), pp. 319–32 (7 figs.).

„ **Gold-Cadmium Alloys.** *Tom. cit.*, pp. 333–46 (8 figs.).

The Metallurgy of Cast Iron.
[A review of T. D. West's book with this title.]
English Mechanic, lxxxiv. (1906) pp. 347–8.

Metallic Vegetation. *Tom. cit.*, p. 419.

Recording Types of Le Chatelier Pyrometer.
Electrochem. and Met. Ind., iv. (1906) pp. 511–2 (2 figs.).

Cementation Experiments with Gas or Gaseous Cementing Agents.
Metallurgie, iii. (1906) pp. 123–8 (20 figs.).

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 19TH OF DECEMBER, 1906, AT 20 HANOVER SQUARE, W.
DR. D. H. SCOTT, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 21st of November, 1906, were read and confirmed, and were signed by the President.

The List of Donations to the Society (exclusive of exchanges and reprints) received since the last Meeting, was read, and the thanks of the Meeting were voted to the donors.

	From
Proceedings of the Optical Convention	*The President of the Optical Convention.*
Photographic Portrait of the late Andrew Ross	*Mr. Edward Praill.*
A Dissecting Stand and Live Box made by the late Mr. Latimer Clark	*Mr. C. L. Curties.*

The thanks of the Society were voted to the donors.

Mr. C. L. Curties, in reply to the President, said that the two old instruments which he had presented to the Society, were found amongst the possessions of the late Mr. Latimer Clark, and it was thought they would be of interest to the Society as he was one of its oldest Fellows.

Mr. C. Beck exhibited a new form of hand demonstration Microscope for low power objects, which was designed for use in classes, to be handed round to members.

The President thought this was likely to be a very useful instrument; it could be used, for example, for the demonstration of sections of fossil plants under a low power, only for this purpose the stage would have to be made somewhat larger.

The thanks of the Meeting were voted to Mr. Beck for his exhibit.

The President called attention to the exhibition by the Society of a selection of the slides presented to them by Mr. James Hilton, which had been arranged by Mr. Rousselet.

Mr. Rousselet said these slides were some which he had selected from Mr. Hilton's collection—they did not illustrate any special subject, but were quite of a miscellaneous character.

Mr. F. Rogers read his paper, "On the Microscopic Study of Strain in Metals," the subject being illustrated by photographs, and specimens shown under Microscopes lent for the occasion by Messrs. Beck.

The President said this was a subject which must be of great interest to many of the Fellows; he would not attempt to say anything himself, but had no doubt that some of those present would wish to discuss the paper.

Mr. W. Rosenhain said that it was very difficult to discuss Mr. Rogers' paper in that assembly, because it dealt with a special branch of a highly technical subject, and he hoped that the results described in the paper would be brought before an assembly of metallurgists, where they could be adequately discussed. If, however, there were any amateurs interested in the subject present, he would like to warn them that there were one or two of Mr. Rogers' statements which, perhaps, required a little care in their application. For instance, Mr. Rogers seemed to consider it likely that such substances as pearlite did not possess a crystalline structure, and that, consequently, their behaviour under stress was essentially different from that of crystalline metals. Of course it was not easy to see what was the physical structure of some of these bodies, more particularly of some of the transition products, but he (Mr. Rosenhain) thought that there was some evidence for believing that the structure of well-developed pearlite was crystalline; the subject was, however, one that required much further investigation.

The whole question of the behaviour under various stresses of metals consisting of two constituents of widely different mechanical properties, was a very interesting, but also a very difficult one. Mr. Rogers had studied the behaviour of such metals under alternating stresses, while the speaker had studied their fracture under various other forms of loading, and he would like to point out that the conclusions as to the path of fracture in a heterogeneous metal of this kind, depended upon the nature of the forces producing the fracture, the deciding factor being the presence or absence of considerable deformation prior to actual fracture. From this result one would expect Mr. Rogers' specimens to show two types of fracture; those portions of any specimen which had broken first, while the specimen was stiff enough to resist any considerable bending, would show the "cleavage type" of fracture, while those portions of the fracture which broke last would show the effects of sensible bending, which must begin as soon as the specimen had fractured to a certain definite extent.

Perhaps the most interesting portion of Mr. Rogers' work was that dealing with the very beautiful application of heat-tinting, to the study of these fractures which Mr. Rogers has introduced. The results obtained in that way were most valuable, but he supposed that only those fissures were represented by tinted areas on the broken specimen

which had reached the surface of the specimen, and had thus been open to the atmosphere when the specimen was heated? He (the speaker) was incidentally surprised to hear Mr. Rogers refer to a temperature of 250° C. as not being an "annealing temperature"; since metal in that over-strained and sensitive condition was known to be affected by temperatures as low as 100° C., it was surprising to find that 250° C. produced so small a result as that found by Mr. Rogers.

The branch of metallography to which Mr. Rogers' paper formed a contribution, was a very large and important one, destined, he believed, to lead to the most important results. Some seven years ago, Professor Ewing had initiated this work, at all events, so far as England was concerned, and as the speaker had had the good fortune to be the first of those who had been induced to take it up, he was particularly gratified to find that the subject was now being pursued by an increasing number of able workers, such as Mr. Rogers.

Captain Howarth said he had listened to the two speakers with great interest, but though he was not prepared to enter into the discussion, he might mention that the inner tubes of guns were sometimes not quite what they should be, and that they showed a tendency to crack—and anything which would throw light on this subject would be of immense use.

Mr. Rogers said it was hardly necessary on the present occasion to argue out the points which had been mentioned, as it would be found that he had intentionally used words in the paper which should avoid controversy on this side issue, and his views on several points were very similar to those held by Mr. Rosenhain. He thought, however, that it was a question as to whether there was any orientation of crystallisation in pearlite. As regards the opinion expressed that the beginning of a fracture was probably of a different nature from the later stage, he agreed that this was quite so, and the results of his investigations quite bore out one of Mr. Rosenhain's ideas. 250° C. was, of course, in one sense, an annealing temperature, but it was not one ordinarily used in practice for steels of the nature of those he was dealing with. He believed Mr. Rosenhain would have liked to go much further with his remarks, and he could only regret that he had not done so. He could hardly say that his experiments would at present show much as to the cause of the cracks which, as Captain Howarth pointed out, were observed in gun tubes, but they formed one method of gaining information systematically upon the nature of breakdown, from which eventually it might be possible to form conclusions as to the probable cause of failure in any particular case.

On the motion of the President, a vote of thanks was unanimously accorded to Mr. Rogers for his paper, and to Mr. Rosenhain for the remarks which he had made upon it.

The Secretary announced that the following Fellows had been nominated by the Council as the Officers and Council of the Society for

the ensuing year, for whom a Ballot would be taken in the usual way at their next Meeting.

President—The Right Hon. Lord Avebury, F.R.S., etc.

Vice-Presidents—Messrs. Beck, Disney, Eyre, and Scott.

Council—Messrs. Carr, Allen, Karop, R. Moreland, Plimmer, Powell, Price-Jones, Radley, Rheinberg, Rousselet, Spitta, and Sir Ford North.

Treasurer—W. E. Baxter.

Secretaries—W. H. Dallinger and R. G. Hebb.

Librarian—P. E. Radley.

Curator—C. F. Rousselet.

Mr. J. M. Allen was appointed as Auditor of the Society's accounts on behalf of the Council, and the Fellows present were asked by the President to elect one of their number as Auditor on behalf of themselves.

Mr. C. L. Curties was thereupon proposed, seconded, and duly elected as Auditor on behalf of the Fellows of the Society.

A vote of thanks to Messrs. Beck was unanimously passed for the loan of the Microscopes, under which the specimens in illustration of Mr. Rogers' paper were exhibited.

It was announced that their next Meeting would be their Anniversary, at which the Report and Accounts for the year 1906 would be submitted, and Officers and Council for the ensuing year would be elected, and the retiring President would give his Annual Address, the subject of which would be, "The Flowering Plants of the Mesozoic Age in the Light of Recent Discoveries."

It was also announced that the Rooms of the Society would be closed from December 21st to 31st.

The following Instruments, Objects, etc., were exhibited:—

The Society:—Photographic Portrait of the late Andrew Ross; Dissecting Stand and Live-Box in wood, made by the late Latimer Clark, C.E.

The following slides selected from the Collection recently presented by Mr. James Hilton:—Argus Butterfly, Battledore scales; Aventurine, Black Coral (Antipathes); Butterfly scales, *Papilio Amphinome*; Decomposed ancient glass; Foraminifera, Lagenæ, selected; Gorgonia spicules; Scale from a leaf, the work of a fly; Sand from New Providence, Bahamas; Sponge cuticle, from Fremantle; Sponge, section showing banded arrangement of spicules; Sponge, Grantia sp.; Sponge, Geodia Baretti, ditto spicules; Tertiary Fossils; Volvox, mounted in 1849.

Mr. F. Rogers:—Photographs, and the following Objects in illustration of his paper:—

1. A specimen of circular cross-section, for mechanical test only.

2. A specimen of rectangular section, with one longitudinal face prepared for microscopic examination of strain effects.

Microscope Specimens.

	Steel.	Carbon per cent.	Heat Treatment.	Features.
3	B	0·14	Annealed at 805° C. for ½ hour	Showing crack to naked eye
4	C	0·32	As rolled	Just before rupture
5	C	0·32	Annealed at 675° C. for ½ hour	"Normal" class
6	C	0·32	Annealed at 785° C. for ½ hour	Between "normal" and "overheated"
7	C	0·32	Annealed at 1025° C. for ½ hour	"Overheated"
8	D	0·58	As rolled	"Normal." Shows also two types of fracture—the first and later portions
9	D	0·58	Annealed at 1200° C. for 2 hours	"Overheated"
10	A	0·27	See Table, specimen 6	

New Fellows.—The following were elected *Ordinary* Fellows of the Society:—Mr. William McGregor Cairncross, Rev. John Brunsdon Fletcher, and Mr. T. H. Hiscott.

ANNIVERSARY MEETING

Held on the 16th of January, 1907, at 20 Hanover Square, W., The President, Dr. D. H. Scott, F.R.S., etc., in the Chair.

The Minutes of the Meeting of the 19th of December, 1906, were read and confirmed, and were signed by the President.

The following Donation was announced, and the thanks of the Society were given to the donors.

From

David S. Stead—Fishes of Australia. (8vo, Sydney, 1906) .. *The Board of Fisheries for New South Wales.*

Dr. Hebb called attention to some stereo-photo-micrographs that Mr. Dollman, of Adelaide, had sent over.

The President having appointed Mr. H. Taverner and Mr. T. J. Smith to act as Scrutineers, the ballot for the election of Officers and Council for the ensuing year was proceeded with.

The President called attention to an exhibition of fresh-water Polyzoa, which had been arranged under Microscopes on the table by Mr. C. F. Rousselet.

Mr. Rousselet said that this collection included nearly all the known species of fresh-water Polyzoa, several amongst them being very rare, and others not yet found in this country.

The thanks of the Society were unanimously voted to Mr. Rousselet for the trouble he had taken in the matter.

The Secretary then read the Report of the Council for the year 1906, as follows :—

REPORT OF THE COUNCIL FOR 1906.

FELLOWS.

Ordinary.—During the year 1906, 20 new Fellows have been elected, whilst 13 have died, and 12 have resigned. Among the Fellows who have died during the past year, the Council regrets to notice the names of Lionel Smith Beale, F.R.S., a former President; John Jewell Vezey, Treasurer of the Society; and of Walter Frank Raphael Weldon, F.R.S.

Honorary.—The number of Honorary Fellows, 42, remains the same as in the previous year.

The list of Fellows now contains the names of 409 Ordinary, 1 Corresponding, 42 Honorary, and 82 Ex-Officio Fellows, being a total of 534.

FINANCE.

Although the amount received for subscriptions during the past year is somewhat larger than that in the previous account, a small debit balance is shown on the 31st December. This is partly due to the investment this year of a legacy received in 1905, in addition to the admission fees.

It again appears necessary to point out that the number of new Fellows elected has not of late years kept pace with the loss by deaths and resignations. Fellows are therefore urged to do their best to enlist new Members.

JOURNAL.

The Journal, which is fully up to the standard of previous years, contains 13 papers and 5 notes, as well as the summary of current researches relating to Zoology, Botany, and Microscopy.

It is agreeable to notice that the number of communications made to the Society and recorded in the Transactions is above the average of recent years. These papers have been more copiously illustrated than for some time, the number of plates being 21.

The thanks of the Council are due to the Editorial staff for the continuance of their labours and their excellent contributions.

LIBRARY.

The Library is in good order, and owing to the generosity of authors and publishers important new works have been added to the collection during the past year. It is hoped that during 1907 a shelf catalogue will be undertaken, a new feature which will facilitate the checking of books on loan.

INSTRUMENTS AND APPARATUS.

The Instruments and Apparatus in the Society's Collection continue to be in good condition.

During the past year the following additions have been made :—

April 18, 1906.—An Old Microscope. Presented by Mr. H. J. Morgan.

Oct. 17.—A Pocket Microscope. Presented by a Member of the Quekett Microscopical Club.

Oct. 17.—An Old Microscope by E. Culpeper. Presented by the Treasurer.

Nov. 21.—An Old Microscope, John Cuff Model, made by Dollond. Presented by Mr. Chas. Lees Curties.

Dec. 19.—A small home-made, wooden Dissecting Microscope, and a Live-Box, made by Mr. Latimer Clark. Presented by Mr. Chas. Lees Curties.

CABINET.

During the past year the Society's collection has been enriched by the following donations :—15 Slides of the Oribatidæ, presented by Mr. N. D. F. Pearce ; 23 Slides of Foraminifera from the gault of Folkestone, presented by Mr. F. Chapman, who depicted and described the specimens in the Journal of the Society. Nearly 900 Slides, presented by Mr. James Hilton ; this last collection has yet to be examined and the suitable preparations catalogued.

In addition to the foregoing the Society received from M. Alfred Nachet, of Paris, a gift of peculiar scientific interest. This donation consists of six Micro-daguerreotypes taken by the aid of the electric light by Léon Foucault in 1844.

Mr. Wynne Baxter, the recently appointed Treasurer of the Society said, "that before reading the Cash Statement and Balance Sheet he would remind the Fellows that, as he only took up the duties in March last on the death of Mr. Vezey, his record did not comprise a complete year, but he should like to take the opportunity of bearing testimony to the admirable manner in which the Society's accounts had been kept by Mr. Vezey, and, although his death was very sudden, the books were found to be in perfect order and were posted up to within a few days of the occurrence." The audited Balance Sheet and Statement of Accounts for the year 1906 was then read to the Meeting.

Mr. W. J. Marshall moved, "That the Report and Balance Sheet be received and adopted, and that they be printed and circulated in the usual way."

Dr. CASH STATEMENT FOR THE YEAR ENDING 31st DEC. 1906. Cr.

1906.	£	s.	d.	£	s.	d.
To Balance from 1905				72	17	9
" Admission Fees				35	14	0
" Compounding Fee				10	10	0
" Annual Subscriptions—						
1903	£2	2	0			
1904	12	1	6			
1905	31	1	3			
1906	573	5	1			
1907	25	3	3			
1908	2	8	0			
1909	0	2	3			
				646	3	4
" Interest on Investments				61	10	6
" Sale of Journal				285	14	6
" Receipts for Advertisements				60	0	0
" " " Sale of Surplus Books				6	0	0
" " " Reprints and List of Fellows				3	9	5
" Income Tax returned				3	0	8
Debit balance				20	10	5
				£1205	10	7

1906.	£	s.	d.	£	s.	d.
By Rent, Coals, etc.				132	10	0
" Salaries and Reporting				166	17	0
" Books purchased				91	0	3
" Bookbinding				9	9	2
" Expenses of Journal—						
Editing	£160	18	6			
Illustrations	46	15	2			
Printing and Postage	398	15	9			
				606	9	5
" Purchase of 120*l.* Water Board B Stock				117	16	0
" Refreshments at Meetings				13	10	0
" Stationery				15	4	8
" Fire Insurance				3	5	0
" Postage and Petty Cash				45	8	1
" Rent of Stock of Journal				3	3	0
" Repairs				0	18	0
				£1205	10	7

Investments.

	£	s.	d.
North British Railway	400	0	0
Nottingham Corporation Stock Three per Cents.	400	0	0
New South Wales Three and a Half per Cents.	315	11	1
India Three per Cents.	863	19	7
Metropolitan Water Board B Stock	120	0	0
	£2099	10	8

WYNNE E. BAXTER, *Treasurer.*

We have examined the foregoing Account, and compared the same with the Vouchers in the possession of the Society; we have also verified its Securities as above mentioned, and find the same to be correct.

January 9, 1907.

J. MASON ALLEN } *Auditors.*
C. LEES CURTIES }

Mr. K. I. Marks having seconded the motion, it was put to the Meeting by the President, and carried unanimously.

The President said that happily there was little in the Report for the past year which called for remark. It had been a satisfactory year, even if in one point it had not been quite what they could wish, for they could not forget that the Report showed that there had been a slight falling off in the number of Fellows during the year. He was sure that no one who had occupied the Chair as he had done for the past three years could have any doubt as to the value of the work done by the Society, which was largely of a kind not done by any other society. He should like, therefore, to ask those present to do what they could towards increasing their numbers during the new year on which they were entering.

The Scrutineers having handed in the result of the Ballot, the President declared the following to have been elected :—

President—The Right Hon. Lord Avebury, P.C. F.R.S., etc.

Vice-Presidents—Conrad Beck ; A. N. Disney, M.A. B.Sc. ; J. W. H. Eyre, M.D. F.R.S. (Edin.) ; Dukinfield Henry Scott, M.A. Ph.D. F.R.S. F.L.S.

Treasurer—Wynne E. Baxter, J.P. F.G.S. F.R.G.S.

Secretaries—Rev. W. H. Dallinger, LL.D. D.Sc. D.C.L. F.R.S. F.L.S. F.Z.S. ; R. G. Hebb, M.A. M.D. F.R.C.P.

Ordinary Members of Council—Jas. Mason Allen ; Rev. Edmund Carr, M.A. F.R.Met.S. ; George C. Karop, M.R.C.S. ; Richard Moreland, M.Inst.C.E. ; The Right Hon. Sir Ford North, P.C. F.R.S. ; Henry Geo. Plimmer, F.L.S. ; Thomas H. Powell ; C. Price-Jones, M.B. (Lond.) ; P. E. Radley ; Julius Rheinberg ; Chas. F. Rousselet ; E. J. Spitta, L.R.C.P. (Lond.) M.R.C.S. (Eng.).

Librarian—Percy E. Radley.

Curator—Charles F. Rousselet.

The President then delivered his Annual Address, taking as his subject "The Flowering Plants of the Mesozoic Age in the light of Recent Discoveries," which was illustrated by a large number of excellent lantern slides.

Dr. Henry Woodward said he had very great pleasure in asking the Fellows of the Society to return their thanks to the President for his admirable address, and to ask him to allow that the same might be printed. They could not but feel exceedingly grateful to Dr. Dukinfield Scott for the admirable address he had given them, and for the connective tissue by which he had now brought this series of discourses to its completion. He had conducted them from the Angiosperms to the fossil seed-bearing plants of the Coal Period on to the Cycadaceæ of the Secondary rocks, and these to the higher flower-bearing forms, by a successive series of stages, and had shown them that evening the probable birth-origin of the flowering plants from the Cycads. The very beautiful slides he had exhibited would leave these things strongly impressed upon their memories. The subject of the President's addresses bore

directly upon the practical work of the Society, for they would of course see where the application of the Microscope came in. The study of the Coal-Measure plants attested the value of microscopical research, since their knowledge of these plant structures was based upon their president's examination of a long series of beautifully prepared sections, the study of which led to an accurate knowledge of these primitive plants. It was very interesting to notice that the fossil insects found in the Coal-Measures confirmed what Dr. Scott had told them, for when the only plants which existed produced neither pollen nor honey, they found only such insects as predaceous Dragon-Flies (Neuroptera), the Orthoptera, which include the Cockroaches, Locusts and Grasshoppers, and the Hemiptera which lived upon the juices of plants, Fulgoridæ (Lantern-Flies) the Cicadidæ, etc., but when flower-bearing plants appeared they found evidences of the honey-eating insects such as Lepidoptera and Hymenoptera. They might now look forward to the treatment of similar subjects by their newly elected President (Lord Avebury), who was full of information upon insect-life and the connection of insects and flowers. He had great pleasure in moving this resolution.

Mr. G. C. Karop had much pleasure in seconding the motion, which was carried by acclamation.

Dr. Scott, in thanking Dr. Woodward for his very kind remarks, said he should like to ask him what was the earliest period at which the Lepidoptera had been found to appear.

Dr. Woodward said a Lepidopterous insect had been found in the Great Oolite or Stonesfield Slate, i.e. in the age of the Cycadeæ—this had been doubted by Scudder, but Dr. A. G. Butler still stoutly defends it.

Dr. Scott said it had been a great pleasure to him to have given this series of addresses, and he should of course be pleased, as the Society wished it, to give permission to have the one printed which had been delivered that evening. He felt much indebted to the Society for the kind way in which they had received his address; he could only speak to them as a Botanist, and to an audience not wholly botanical the matters discussed must necessarily sometimes appear rather special. He was exceedingly pleased to think that his successor was to be Lord Avebury; he was very happy to be able to make this announcement, for if they were to increase in numbers he could not conceive of a more auspicious circumstance than the presidency of Lord Avebury, nothing could do the Society more good than the influence of a man of science at once so eminent and so popular.

Mr. Maurice Blood proposed that the thanks of the Society be given to their Honorary Officers. How much they owed to them was only known to those who worked with them in what was entirely a labour of love.

Mr. Plaskitt having seconded the motion,

Dr. Scott said he had never known the work of any society to be carried on so smoothly as in this one, or in which the President's office was rendered so easy for him, owing to the excellent way in which the affairs of the Society were managed by its officers. He had remarked this on former occasions and could now say it again after a longer experience. In the interval since their last Annual Meeting, they had

sustained a very sad loss in the death of their late Treasurer, Mr. Vezey, for whom he had formed a warm regard, but they were glad to know that Mr. Baxter had taken up the work with his equal ability and zeal.

The motion was then put to the Meeting and unanimously carried.

Dr. Hebb, on behalf of his colleagues, returned thanks for the vote just passed, but desired to include in the motion the name of Mr. Parsons, in order to express his appreciation of the excellent way in which the secretarial work was carried out, for it was owing to Mr. Parsons's care that the smooth working of the Society's affairs was in great measure due.

Dr. Scott said he very cordially supported Dr. Hebb's remarks as to the services rendered to the Society by Mr. Parsons.

Mr. C. D. Soar then moved a vote of thanks to the Auditors and Scrutineers, which, having been seconded by Mr. Gardner, was put to the Meeting and carried unanimously.

The following Objects were exhibited:—

Dr. Hebb:—The following Stereo-photo-micrographs received from Mr. Dollman, of Adelaide: *Volvox globator* × 35; Cornea of Eye of Beetle × 200; *Aulacodiscus* × 250; *Actinoptycus* × 400; *Triceratium* × 400; *Coscinodiscus spiniferus* × 400 (pseudoscopic); *Navicula lyra* × 1000.

Mr. C. F. Rousselet:—Freshwater Polyzoa: *Alcyonella fungosa*; ditto, Young emerging from statoblasts; *Arachnoidia Ray-Lankesteri*, from Lake Tanganyika; *Cristatella mucedo*; ditto, Statoblasts; *Fredericella sultana*; *Lophopus crystallinus*; ditto, Statoblasts; *Lophopodella Thomasi*, Statoblasts, from Rhodesia; *Membranipora monostachys* var. *fossaria*, from brackish water near Great Yarmouth; *Pectinatella gelatinosa*, from Japan; ditto, Statoblasts; *Pectinatella magnifica*, from the Havel, near Berlin; *Paludicella Ehrenbergi*; *Plumatella repens*; ditto, Statoblasts; *Victorella pavida*.

New Fellows.—The following were elected *Ordinary* Fellows of the Society:—Dr. Hermann Ambronn and Mr. Robert Paulson.

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Journal of the Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(Principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

EDITED BY

R. G. HEBB, M.A. M.D. F.R.C.P.

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

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Regius Professor of Natural History in the University of Aberdeen

A. N. DISNEY, M.A. B.Sc. CECIL PRICE-JONES, M.B. LOND.

FELLOWS OF THE SOCIETY

AND

A. B. RENDLE, M.A. D.Sc. F.L.S.
Keeper, Department of Botany, British Museum

HAROLD MOORE, B.Sc.
Woolwich Arsenal

Minimis partibus, per totum Naturæ campum, certitudo omnis innititur quas qui fugit pariter Naturam fugit.—*Linnæus.*

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Authors of Papers printed in the Transactions are entitled to 25 copies of their communications *gratis*. Extra copies can be had at moderate charges on application to the Assistant Secretary.

Fig. 1.—Cycadeoidea marylandica.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

APRIL, 1907.

TRANSACTIONS OF THE SOCIETY.

III.—*The President's Address: The Flowering Plants of the Mesozoic Age, in the Light of Recent Discoveries.*

By Dukinfield H. Scott, M.A., LL.D., F.R.S.

(*Read January* 16*th*, 1907.)

Plates VI. to IX.

The subject which I have chosen for my address to-night relates to the Flora of a period very remote from the present day, though not so remote by far as periods of which I have had occasion to speak at previous meetings of the Society. We then referred to the plants of the Palæozoic period, embracing a vast range of time; the strata with which we were actually concerned were the Permian, the Carboniferous, and, in a lesser degree, the Devonian, of which the Flora is still imperfectly known. My remarks to-night relate to the plants of Mesozoic or Secondary age, ranging from the Trias, through the Jurassic, to the Cretaceous: the great period which bridges the gulf between the antique vegetation of Palæozoic days, and the essentially modern type of Flora which characterises the Tertiary formations.

EXPLANATION OF PLATE VI.

For figs. 1, 4, 5, and 6, I am indebted to the kindness of Dr. Wieland, who was so good as to send me proofs of illustrations from his book.

Fig. 1.—*Cycadeoidea marylandica.* The earliest described American fossil Cycad. From an original daguerrotype. Nearly thirty young fruits are marked in the present view by the groups of bract scars interpolated between the old leaf-bases. About one-fourth natural size. From Wieland's "American Fossil Cycads."

We all remember the general character of the Carboniferous forests, from which our conceptions of Palæozoic plant-life are chiefly drawn—their gigantic Lycopods and scarcely less gigantic Horsetails, together with the vast assemblage of plants with the habit of Ferns, the majority of which, however, as recent research has shown, were in reality seed-bearing forms, though not without Fern-affinities.* There were, in addition, trees of a far higher type of organisation, recalling, in their habit and the structure of their stems, some of the Coniferæ of the Southern Hemisphere, though sufficiently distinct in other characters to constitute an order of their own—the Cordaiteæ. Both they and the Fern-like Pteridosperms were Seed-plants, Spermophytes. We have abundant evidence of the existence of Seed-plants in very early days, in fact, practically as far back in the Palæozoic as our records of terrestrial plants extend. To-night, however, I am going to speak of Flowering Plants, by which I do not mean the same thing as Seed-plants, though the two terms have often been used as synonymous. One of the results of the discoveries in Palæozoic Botany already mentioned has been to show that the seed-bearing and flower-bearing characters by no means coincide, for the fern-like Seed-plants of Palæozoic age were in no sense of the words Flowering Plants. The evidence shows that their seeds, like the fructification of ordinary Ferns, were borne on leaves differing but little from the vegetative fronds and not aggregated on any special axis as are the parts of a flower. The nearest and, indeed, the only analogy to be found among recent seed-plants, is in the female plant of *Cycas*, to which we shall return presently. The Mesozoic plants, however, with which we are concerned to-night were not only Seed-plants, but they bore their reproductive organs in a form which everyone would naturally describe as a flower. They were Flowering Plants in the full sense of the term, however different in other respects from the Flowering Plants of the present day.

The Mesozoic floras from the Upper Trias to the Lower Cretaceous maintain, on the whole, a very uniform character, widely different from that of the preceding Palæozoic vegetation. The Lycopodiaceous trees have disappeared; the gigantic Horsetails have given place to forms more like the Equiseta of our own day; the fern-like Seed-plants are no longer conspicuous, and the Cordaiteæ are gone. True Ferns, on the other hand, are abundant, more so, no doubt, than in the earlier period; true Conifers, often much resembling recent genera, are now a dominant group; the family now represented by the Maidenhair tree (*Ginkgo*) is prevalent, but the most striking feature of the vegetation is the abundance, in all parts of the World, of plants belonging to the class of the Cycads, now so limited a group.

* See President's Address for 1905, "What were the Carboniferous Ferns?" this Journal, April 1905.

I will only refer to the Conifers in passing; they are of much interest to the botanist, who is naturally anxious to obtain evidence as to the relative antiquity of the various constituent families, but there is nothing sensational, as yet, about the Mesozoic Coniferæ, which, so far as our present very imperfect knowledge shows, did not differ in any very striking way from the Araucarias, Pines and Cypresses of our own time.

We will concentrate our attention on the Cycad-like plants, or Cycadophyta, to adopt the broader class-name, appropriately suggested by Professor Nathorst. The living Cycadaceæ, of which some account has been given on a previous occasion,* are, it will be remembered, quite a small family, embracing only nine genera, and, according to a recent estimate, about 100 species, inhabiting the tropical or sub-tropical regions of both the old and new worlds, but nowhere forming a dominant feature in the vegetation. Throughout the Mesozoic period, however, at least until the Upper Cretaceous is reached, plants with the habit and foliage of Cycads are extraordinarily abundant, in all regions from which secondary fossils have been obtained; they are as characteristic of Mesozoic vegetation as the Dicotyledons of our recent flora. In many cases the fossil leaves closely simulate those of living genera (*Zamites*, *Dioonites*, *Cycadites*), others, such as *Otozamites* and *Anomozamites*, bear a more general resemblance to the Cycadean type of foliage. Trunks, described under the names of *Bucklandia*, *Fittonia*, and *Yatesia*, recall vividly those of living genera; in the first-named form an alternation of the scars of foliage and scale leaves has been traced such as is found in *Cycas* at the present day. The silicified stems, with structure preserved, confirm by their anatomical characters the Cycadean relationship indicated by the external features. Specimens of these various kinds are characteristic of the Mesozoic floras in all parts of the world, and there is thus a vast body of evidence for the abundance, during that period, of plants showing Cycadean characters.†

The most important point, however, in questions of affinity is the fructification. Throughout the recent Cycads this is of a simple type; in all the genera the staminate fructification is a cone, consisting of an axis densely beset with scales or sporophylls, each sporophyll bearing on its lower surface a number—often a very large number—of pollen-sacs, grouped, like the sporangia of a fern, in small sori. In eight out of the nine genera the female fructification is also strobiloid, each sporophyll bearing two marginal ovules. In the Mexican genus *Dioon* the scales of the cone are much expanded and have a somewhat foliaceous character. In *Cycas* itself, however, so far as the female plant is concerned, we

* See this Journal, 1905, p. 148.

† See A. C. Seward, Address to Botanical Section, British Association Report for 1903.

find a much more primitive arrangement; no cone at all is differentiated, but the carpels are borne directly on the main stem of the plant, in rosettes alternating with those of the vegetative leaves; thus there is no special reproductive axis, but the sporophylls spring from the axis of the plant as a whole, just as in an ordinary fern. The carpels themselves are lobed and extremely leaf-like, bearing as many as six ovules in many cases, though in one species the number is reduced to two. Thus in *Cycas* the seeds are borne on organs still obviously leaves, and nothing of the nature of a flower is differentiated. No other living seed-plant is so primitive as this, but the Cycads as a whole are undoubtedly the most primitive family of present-day Spermophyta, as is most strikingly shown in their cryptogamic mode of fertilisation by means of spermatozoids, which they share with *Ginkgo* alone among Seed-plants.

When we go back to the Mesozoic age we might, on what one may call the elementary view of evolution, expect to find the Cycadophytes which were so abundant at that period, still simpler, and still nearer the cryptogamic condition than the members of the class which have come down to our own day. But this is by no means the case; there were, no doubt, a certain number of Cycads in Mesozoic times which were about on the same level of organisation as their living representatives, but the great majority, so far as the available evidence shows, attained a much higher organisation, at least in their reproductive arrangements, far surpassing any of the Gymnosperms now known to us. This is one of the many facts in palæontology which show that evolution is by no means the obvious progression from the simple to the complex which many people have imagined. Just as the Lycopods and the Horsetails

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EXPLANATION OF PLATE VII.

Fig. 2. *Bennettites Gibsonianus.* A. Diagram of the fructification in radial section. *rc*, receptacle; *br*, bracts, overlapping at the top of the fruit; *s*, seeds, seated on long pedicels, and each containing a dicotyledonous embryo; *p*, dilated ends of the interseminal scales (which should be more numerous) forming the "pericarp." B. Ramenta, like those of Ferns, in transverse section. × about 15 diam. C. Transverse section of a seed. *i*, the double-layered testa; *n*, membrane representing the nucellus; *ct*, the two cotyledons of the embryo, showing the young vascular bundles. × about 12 diam. D. Somewhat oblique longitudinal section, passing through the micropyle of a seed. *em*, radicle-end of embryo; *r*, apex of radicle; *e*, remains of endosperm (?); *m*, micropyle, obliquely cut; *i*, outer layer of testa; *p*, part of pericarp; *c*, *c*, crevices in pericarp, corresponding to the limits of the interseminal scales composing it. × 20 diam. From Scott's "Studies in Fossil Botany."

,, 3. *Bennettites Gibsonianus.* Longitudinal section of seed, showing the dicotyledonous embryo. *c*, *c*, the two cotyledons; *a*, apex of plumule; *b*, radicle. × 12 diam. Photograph, from Scott's "Studies in Fossil Botany."

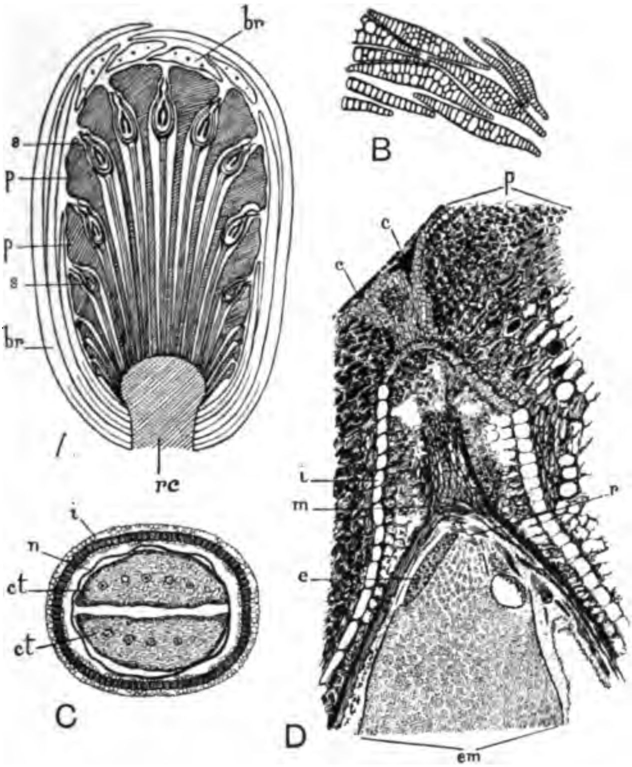

Fig. 2.—Bennettites Gibsonianus.

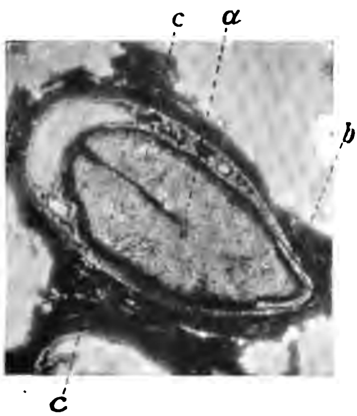

Fig. 3.—Bennettites Gibsonianus.

The blocks for this Plate (VII., Figs. 2 and 3) were kindly lent by Messrs. A. & C. Black.

of the Coal Measures were not simpler, but far more complex than their successors, so the Cycadophyta of Mesozoic age were, on the whole, on a much higher level than the surviving family Cycadaceæ, which now represents them. The history of the vegetable kingdom, so far as its records are known, is the history of the ascendancy of a succession of dominant families, each of which attained at some definite period its maximum, both in extent and organisation, and then sank into comparative obscurity, or died out altogether, giving place to some other race, which, under changing conditions, was better able to assume the leading *rôle*. The Cycadophytes of the Mesozoic were, in their day (and it was a long one), a dominant group, almost as much so as the Dicotyledons are now, and they equipped themselves with a correspondingly high organisation, even rivalling the Angiospermous Flowering Plants (perhaps cadets of the same stock), which ultimately displaced them.

Among the Mesozoic Cycadophyta there were some, as already mentioned, which appear to have been essentially similar to our recent Cycads. The genus *Androstrobus*, for instance, appears to represent male cones not greatly differing from those of the living family. A good example from the Rhætic of Sweden has lately been described by Professor Nathorst,* and although the pollen-sacs do not quite agree with those of any recent Cycad, the author has no doubt of its affinity. Carpels much like those of the genus *Cycas* are also known from various Mesozoic horizons, and it is probable that this primitive type already existed as far back as the Triassic period. There is also evidence, though perhaps less convincing, for the presence of the type of the Zamieæ—the Cycads with seeds borne on definite cones—in Rhætic and Jurassic rocks. Thus we find, as we might expect, that the Cycadaceæ, as we know them at the present day, are themselves a very ancient race. I do not, however, propose to dwell on this line of descent, but will now pass on to those Mesozoic Cycadophyta which attained a higher level of organisation, giving them a better title to the name of "Flowering Plants" than any of their predecessors or contemporaries.

The genus *Bennettites* was founded by Carruthers in 1868† for certain Cycadean stems, of Oolitic and Lower Cretaceous age, with fruits borne on secondary axes, not protruding beyond the bases of the petioles. The species on which, for many years, our knowledge of the group was principally based, is *Bennettites Gibsonianus*, of which a magnificently preserved specimen was discovered, just fifty years ago, in the Lower Greensand of Luccombe Chine, in the Isle of Wight. Some years later a second specimen was found in the same locality, but no others have as yet come to light. In

* "Beiträge z. Kenntniss einiger mesozoischen Cycadophyten." Kongl. Svensk Vetensk. Akademiens Handlingar, xxxvi., 1902.

† "On Fossil Cycadean Stems from the Secondary Rocks of Britain. Trans. Linn. Soc. London, xxvi.

B. Gibsonianus, and other species, the external appearance of the stem was similar to that of many recent Cycads, its surface being completely invested by an armour of persistent leaf-bases. Anatomically, there is also a marked agreement, the chief distinction consisting in the simpler course, in the case of the fossil, of the vascular strands which pass out from the stem into the leaves. A striking feature is the presence, in great numbers, on the leaf-base and bracts, of flat, scaly hairs, of the same nature as the ramenta characteristic of Ferns (plate VII. fig. 2, B). Even in external appearance, however, a Bennettitean stem, if in the fruiting condition, differs conspicuously from that of any recent Cycad, in the presence of a number of short, lateral branches, like large buds, wedged in between the leaf-bases, and arising in their axils (see plate VI. fig. 1, from an American species). These bodies are the fructifications, the characteristic feature of the Bennettiteæ. In structure, as well as in position, they differ totally from any form of fructification met with in recent Cycads or other Gymnosperms. The short peduncle has the same anatomical structure as the main stem, on a small scale; it is remarkable, however, for the great development of the phloem, which much exceeds the wood in thickness. This unusual condition may be due to the fact that the crowded reproductive organs, and ultimately the seeds, made a great demand on the food supply, of nitrogenous and other assimilated material, which it is the special function of the phloem to convey.

The peduncle bears many spirally-arranged bracts, which completely inclose the fructification (see diagram, plate VII. fig. 2, A). The end of this peduncle expands into a convex receptacle, on which organs of two kinds are borne—the one fertile, the other sterile. The fertile appendages consist each of a long, slender pedicel, terminating in a single orthotropous seed, with the micropyle directed outwards. The seed-bearing pedicels are present in large numbers; the sterile appendages, or interseminal scales, are still more numerous. They form a dense packing between the seed-pedicels, and somewhat overtop the seeds themselves, expanding at their apices to form an almost continuous envelope, leaving only small perforations, into which the micropylar ends of the seeds are fitted. Towards the base of the receptacle the sterile scales are alone present (see diagram, plate VII. fig. 2, A). They form collectively a kind of pericarp, differing, however, from that of an angiospermous fruit in the presence of openings for the micropyles of the seeds. Both seed-pedicels and interseminal scales are each traversed by a single vascular strand, which in the former case terminates at the base of the seed itself. The whole complex fruit is enclosed in the mantle of overlapping bracts. In *Bennettites Gibsonianus* the fruits discovered are practically ripe, for each seed contains a large, dicotyledonous embryo, with somewhat fleshy cotyledons (see plate VII. fig. 3). The embryo almost

fills the seed, which was thus nearly if not quite exalbuminous—an unprecedented condition in a Gymnosperm. This plant, and a few of its immediate allies, afford the only instances, so far known, of the preservation of the embryo in a fossil seed.*

In the whole arrangement of the floral organs, the presence of a pericarp, and the character of the seed, the fructification differs entirely from anything known in Gymnosperms, and the inclusion of *Bennettites* in Saporta's Class "Pro-angiosperms," appeared justified on grounds of analogy, if not of affinity.

So far, however, nothing whatever was known of the staminate organs of these plants, and no one suspected that the fructifications already known were other than unisexual. Count Solms-Laubach, in conjunction with Professor Capellini, published in 1892 an elaborate investigation of the specimens of Bennettiteæ preserved in the Italian museums. One of the fossils they examined is probably the most ancient palæontological specimen known, I mean historically speaking, for it was found placed as a decoration on an Etruscan tomb, having clearly been recognised as an object of value in pre-Roman days. This specimen (*Cycadeoidea etrusca*) was fruiting, and in one of the fructifications Count Solms-Laubach discovered bodies, interpreted as pollen-grains, lying in the spaces between the top of the ovuliferous column and the enveloping bracts. The preservation was too bad for anything to be ascertained as to the structure of the organs producing the pollen, though some remains of them were present, but the inference was drawn that in this species, and perhaps in other Bennettiteæ, the stamens were borne in the same fructification with the ovules. The evidence was, however, too imperfect to appear decisive at the time. The detailed investigation by Professor Lignier of a magnificent specimen (*Bennettites Morierei*) from the Oxfordian of Normandy,† demonstrated a structure agreeing in essentials with that of the Luccombe species, but brought no further information as to the male organs.

The complete elucidation of the subject was reserved for the American palæontologists, who possess a wealth of material for the investigation of Mesozoic Cycadophyta, far exceeding anything that Europe can show. No less than sixty species of silicified Cycadean trunks have now been described from the Mesozoic of America, ranging from the Upper Triassic to the Lower Cretaceous. Among the numerous localities, the most important are various places on the Rim of the Black Hills of Dakota and the Freezeout Hills of Wyoming (Upper Jurassic to Lower Cretaceous) and the Potomac beds (approximately of Wealden Age), Maryland. The

* Solms-Laubach, "On the Fructification of *Bennettites Gibsonianus*." English translation in Ann. of Bot., v. 1891.

† O. Lignier, "Végétaux Fossiles de Normandie"; "Structure et Affinités du *Bennettites Morierei*." Caen, 1894.

Dakota and Wyoming districts have yielded forty-nine species, and the Maryland localities seven.

The specimens are often extremely numerous; thus the twenty-nine species from the Black Hills of South Dakota are represented by nearly 1000 more or less complete trunks. In fact, the Cycadophyta of the American Mesozoic are as important to the botanist as the gigantic Saurians (with which they are often associated) are to the zoologist.

Plate VI. fig. 1 represents the first American fossil Cycad ever discovered; it was found about 1860 in Maryland, between Baltimore and Washington, by the geologist, Philip Tyson, and well illustrates the external features of the group. A third of a century elapsed before any further discoveries were made, so the present magnificent material has been accumulated within quite a short period. The systematic arrangement of the specimens has been principally the work of Professor Lester Ward, while the morphological investigation has fallen to the share of Dr. Wieland, of Yale University, to whom the discoveries we have now to consider are due.

It may be mentioned, in passing, that the American palæobotanists use Buckland's generic name *Cycadeoidea* for plants which in Europe we should refer to Carruthers' genus *Bennettites*. Buckland's genus was founded on trunk-characters, while the diagnosis of *Bennettites* embraces the fructifications. In referring to Dr. Wieland's work I shall follow him in using the name *Cycadeoidea*, but it must be understood that this is synonymous, so far as we can tell, with *Bennettites*.

The richness of the American material enables us to form a good general idea of the habit of the family. The trunks were in no case very lofty—there seems to be no good evidence for a height of more than 10 or 12 feet, while the great majority of the stems were quite short. In some cases the stems are nearly spherical, and several are connected together, evidently as branches of one plant. In comparing these fossils with recent Cycads, we must, therefore, think of the short-stemmed genera, such as *Bowenia* or *Stangeria*, or at the most *Macrozamia*, rather than of tall plants like *Cycas* itself, some species of which are said to reach a height of 60 feet. In foliage and the external features of the trunk, there was on the whole the same general resemblance to modern Cycads which has already been noted, and the same striking dif-

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EXPLANATION OF PLATE VIII.

Fig. 4. *Cycadeoidea dacotensis*. Longitudinal section of flower. The centre is occupied by the long ovuliferous cone, on either side of which are seen parts of the compound stamens, with rows of synangia on their pinnæ. To the left, some of the bracts are well shown. × 3 diam. Photograph, from Wieland's "American Fossil Cycads."

Fig. 4.—Cycadeoidea dacotensis.

Fig. 5.—Cycadeoidea ingens.

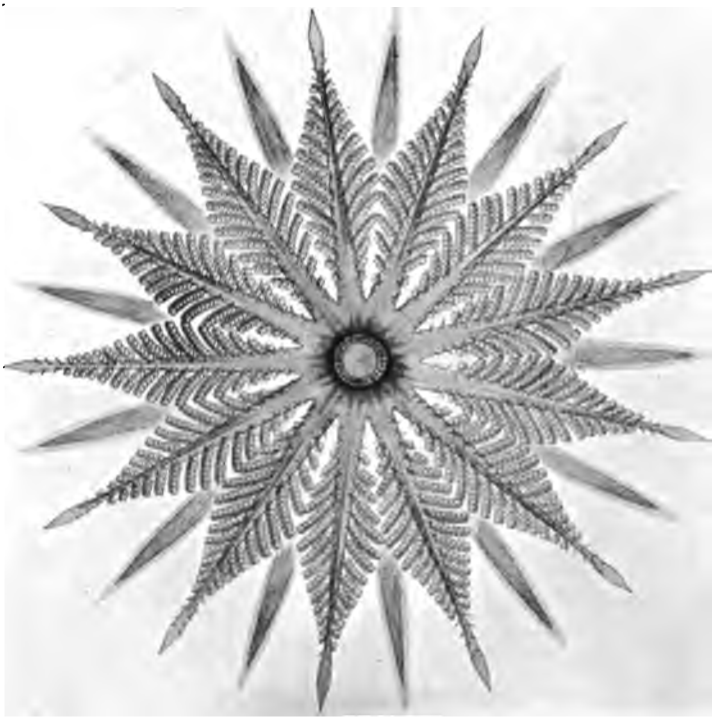

Fig. 6.—Cycadeoidea ingens.

ference in the presence of numerous lateral fructifications. In anatomical structure, the American species so far investigated agree wonderfully closely with the European species of *Bennettites*, but it must be remembered that the vast extent of the material will necessitate many years of arduous research before its investigation can be completed. During the eight years or so that Dr. Wieland has been at work, a marvellous amount has been accomplished. His results are embodied in a magnificent volume issued last August by the Carnegie Institution of Washington.* I will now go on at once to give a brief account of Dr. Wieland's discoveries elucidating the structure of the Bennettitean flower.

The male organs of the Bennettiteæ were first found in 1899, in the species *Cycadeoidea ingens*.† Two years later the important fact was established that the organs of both sexes occurred in the same fructification, the whole thus constituting a "hermaphrodite," or bisexual flower.‡ This discovery, though now of six years' standing, scarcely attracted the attention it deserved, until the publication of the full details within the last few months. Twenty-five trunks bearing bisexual flowers have now been investigated, belonging to seven American species. The conditions in *Cycadeoidea dacotensis*, one of the cases most fully investigated, are as follows. The whole fructification has a length of about 12 cm., and protrudes beyond the leaf-bases of the trunk. About half the length is occupied by the peduncle, the upper part of which bears 100 or more spirally arranged bracts, inclosing the essential organs. The centre is occupied by the ovuliferous cone, about 4 cm. in height, corresponding to the receptacle, with its seeds and other appendages, as shown in the diagram of *Bennettites Gibsonianus*, (plate VII. fig. 2, A). In *C. dacotensis*, however, the form of the central cone is much more pointed, and the stage of development far earlier, immature ovules taking the place of the ripe seeds of the more advanced European specimens (plate VIII. fig. 4).

* American Fossil Cycads. By G. R. Wieland, 1906.

† A Study of some American Fossil Cycads. Part I. The Male Flower of Cycadeoidea. Amer. Journ. Science, vii., 1899.

‡ Op. cit., Part IV. On the Microsporangiate Fructification of *Cycadeoidea*. Amer. Journ. Science, xi., 1901.

EXPLANATION OF PLATE IX.

Fig. 5. *Cycadeoidea ingens*. Restoration of an expanded bisexual flower in longitudinal section, showing the central ovuliferous cone, the compound stamens bearing numerous synangia, and the surrounding bracts, hairy with ramenta. About half natural size. From Wieland's "American Fossil Cycads."

,, 6. *Cycadeoidea ingens*. Plan of the bisexual flower, consisting of a central ovuliferous cone, an hypogynous whorl of compound stamens, united at the base, and a series of spirally inserted enveloping bracts, all shown diagrammatically on about the same scale as fig. 5, and as if pressed out flat. From Wieland's "American Fossil Cycads."

We have to do then, in this case, with an organ in the stage of a *flower*, as distinguished from the *fruit* previously described. The ovuliferous cone, or gynæcium, is completely surrounded by the hypogynous staminate disk, as Dr. Wieland calls it, springing from the rim of the receptacle at the base of the cone (see diagram, plate IX. fig. 5). The stamens are numerous (18–20 in *C. dacotensis*) and arranged in a whorl; their stalks are united to form a continuous sheath, which extends to about the level of the top of the gynæcium. Here they become free from each other; each stamen is a compound, pinnate sporophyll, about 10 cm. long altogether, and is folded inwards towards the gynæcium, the deflexed tip reaching down nearly to its base. The alternate pinnæ, of which there are about 20 pairs, are likewise bent inwards. The pinnæ, with the exception of those at the apex and base of the frond, which are sterile, bear the pollen-sacs in two rows, 10 in each row on the longest pinnæ. Thus the stamens are highly complex structures, resembling the fertile fronds of a fern, rather than the stamens to which we are accustomed in our modern Flowering Plants. The complexity, however, does not end here, for each pollen-sac is itself a compound structure containing two rows of loculi, 10 or more in each row. It thus constitutes a *synangium*, comparable to that of the Marattiaceous ferns, and especially the genus *Marattia*. The similarity to the fructification of such a species as *Marattia Kaulfussii* is, in fact, surprisingly close. It may be added that the vascular system of the stamens is a complex one, consisting of numerous bundles, as in the leaf of a highly organised fern or a Cycad.

It appears that all the specimens actually investigated were in the bud condition, the stamens being still infolded, as described above. Plate VIII. fig. 4 is from one of Dr. Wieland's sections, showing portions of the compound infolded stamens; from the comparison of a number of such sections the author was able to build up the whole construction of the flower. He presumes that the stamens eventually opened out, and the diagrams introduced in figs. 5 and 6 show them in the expanded condition. The ground-plan of the open flower, shown in plate IX. fig. 6, is based on *Cycadeoidea ingens*, a species in which a number of stamens is smaller than in *C. dacotensis*.

It is an interesting fact that in a large number of fructifications in the more mature, seed-bearing condition, Dr. Wieland was able to detect the remains of the staminate whorl seated on the rim of the receptacle. It thus appears that the hermaphrodite condition was general, if not universal, throughout the group, a conclusion which explains Count Solms-Laubach's early observation on *Cycadeoidea etrusca*. As the fruit matured the expanding gynæcium evidently encroached on, and ultimately filled, the space originally occupied by the staminate whorl (compare plate VII. fig. 2, A, with plate IX. fig. 5). Dr. Wieland is of opinion that the flowers must have been protandrous, the pollen being shed before the ovules

were ready for fertilisation. A more detailed knowledge of the condition of the ovules at various stages will be necessary in order to establish this conclusion.

The leading features in the organisation of the Bennettitean flower may be briefly recapitulated as follows: The centre is occupied by the gynæcium, seated on the convex receptacle, and consisting of numerous long-stalked ovules, imbedded among the interseminal scales. Surrounding this central body is the hypogynous whorl of stamens, fused below to form a tube, and expanding above into the pinnate sporophylls, bearing very numerous compound pollen-sacs or synangia, filled with pollen. The whole is surrounded by an envelope of spirally-arranged bracts springing from the upper part of the peduncle. The general arrangement of parts is manifestly just the same as in a typical angiospermous flower, with a central pistil, hypogynous stamens, and a perianth. The resemblance is further emphasised by the fact, long known, that the interseminal scales are confluent at their outer ends, to form a kind of pericarp or ovary-wall. When to these general features we add the practically exalbuminous character of the seed, with its highly organised, dicotyledonous embryo, the indications of affinity with the higher Flowering Plants become extremely significant. The comparison was drawn by Dr. Wieland in 1901, immediately on his discovery of the hermaphrodite flower. The Angiosperm which he specially selected for comparison was the Tulip-tree—*Liriodendron.* The elongated strobiloid fruit, with many carpels spirally arranged in the receptacle, no doubt suggests similarity, and, on general grounds, we should naturally look for analogies among the less specialised polypetalous Dicotyledons, such as Magnoliaceæ, in some of which the leaves of the perianth are spirally arranged. Analogies may also be found in our familiar Ranunculaceæ, such as *Anemone*, or, still better, the Globe-flower (*Trollius*), with its numerous sepals, or, again, in the Water-lilies (Nymphæaceæ). In certain respects, indeed, the Bennettitean flower was in advance of these simpler Dicotyledons, as seen in the arrangement of the stamens, which have abandoned the spiral phyllotaxis of the other organs to range themselves in a definite whorl, while at the same time their stalks are fused into a tube, thus becoming "monadelphous," as in the Mallows of our own flora.

The flower, with its great stamens, 10 cm. long in some species, must have been a striking object when it opened (plate IX. figs. 5 and 6). As, of course, we can know nothing of the coloration of the perianth and other parts, we cannot tell how brilliant its appearance may have been; the bright tints of the carpels and ovules in some recent Cycads, such as species of *Cycas* and *Encephalartos*, suggest the probability that the attractions of colour were not wanting to the more elaborate flowers of the older Cycadophyta; the possibility of a relation to the insect life of the period cannot

be ignored. It is not my intention to push further the comparison of the Bennettitean fructifications with the angiospermous flower; the deeply interesting questions which must suggest themselves to the mind of every botanist, as to how far these manifest analogies are likely to indicate an immediate affinity, will be fully discussed elsewhere by others. Enough has been said to show that the remarkable organs discovered by Dr. Wieland fully merit the name of "flower," in the same sense in which we apply it, in everyday language, to the flowers of our gardens and fields. I am inclined myself to believe that the comparison holds good from a morphological point of view also, but it may be fair to mention that some botanists have regarded each seed-bearing pedicel, with the adjacent interseminal scales, as itself constituting a flower, in which case the whole would, of course, be an inflorescence, comparable to the capitulum of the Compositæ. This interpretation, however, can scarcely be extended to the stamens, which are, to all appearance, seated directly on the receptacle. On the whole, I agree with Dr. Wieland that the simpler view of the whole fructification as a single axis, bearing fertile and sterile organs of a foliar nature, better corresponds to the facts and to the analogies with related groups. The homologies of the seed-pedicels and interseminal scales and especially their relations to the carpellary structures in Angiosperms, in any case present a difficult and fascinating problem to the morphologist.

As stress has been laid so far on the points of agreement with the flower of the Angiosperms, some reference must now be made to characters which indicate relations in other directions. The structure of the gynæcium renders it probable, if not certain, that the Bennettiteæ were still Gymnosperms as regards their mode of pollination, for the openings between the scales of the pericarp leave the micropyles of the seeds exposed (see pl. VII. fig. 2, A). One must therefore suppose that the pollen was received by the ovule directly, without the intervention of a stigma, so that functional Angiospermy had not yet been attained. This is, no doubt, a primitive condition, but it by no means excludes an affinity with Angiosperms. Just as in *Lagenostoma*, the seed of the Pteridosperm *Lyginodendron*, the beak of the nucellus was still the receptive organ for the pollen, in spite of the presence of an integument,* so, in the Bennettitean flower, the micropyle of the seed was still the receptive organ in spite of the presence of a pericarp. The integument in the one case and the pericarp in the other might be termed a "prophetic organ" in the only sense in which such organs exist, i.e. an organ which has not yet assumed all the functions to which it is destined.

The stamens, while by their arrangement and position they

* See Oliver and Scott, "On the Structure of the Palæozoic Seed *Lagenostoma Lomaxi*," Phil. Trans. Roy. Soc., Series B., 197 (1904), p. 231.

suggest those of a typical Angiosperm, carry us back by their structure and form to the sporophylls of a Fern (see plate IX. figs. 5 and 6), so that the characters of the flower as a whole may almost be said to bridge the gulf between Cryptogams and the higher Flowering Plants. The fern-like characters, however, have probably come to the Bennettiteæ not directly from true Ferns, but through the intermediate group of the Palæozoic Pteridosperms. The fact that the pollen-grains are borne in compound pollen-sacs, or synangia, like those of the Marattiaceæ among Ferns, is one of great significance. I should not be disposed, however, to lay quite so much stress on this indication of Marattiaceous affinities as Dr. Wieland has done. The presence of synangia is probably to be explained by the relation of the Bennettiteæ to the Pteridosperms, to which, as we now know, certain of the supposed Marattiaceous fructifications of Palæozoic age really belonged. There can scarcely be a doubt that the Bennettiteæ trace their ancestry through the Pteridosperms and not directly from Filicinean forms, a conclusion in which Dr. Wieland appears to concur.* The true Marattiaceæ of the Palæozoic were probably a less extensive family than has been supposed, and, on present evidence, were less ancient than the Pteridosperms themselves, which we therefore cannot derive from them, though the two groups may have had a common origin. In spite, therefore, of the strikingly Marattiaceous character of the pollen-bearing synangia in Bennettiteæ, I cannot agree with Dr. Wieland in regarding the evidence for their descent from Marattiaceous Ferns as conclusive, but, so far as that particular family of Ferns is concerned, should not assume anything more than an indirect affinity.† None the less, it is impossible to emphasise too strongly the extraordinary combination of characters which the Bennettitean flower presents, uniting in itself features characteristic of the Angiosperms, the Gymnosperms, and the Ferns, and suggesting that the passage from the Filicineæ to the higher Flowering Plants may have been (comparatively speaking) a short cut. The complexity of this earliest known type of a true flower indicates the probability, as Dr. Wieland points out,‡ that the evolution of the Angiospermous flower was a process of reduction. There is thus no longer any presumption that the simplest forms among the flowers of Angiosperms are likely to be the most primitive. The tendency of the older morphologists to regard such flowers as reductions from a more perfect type appears fully justified by the discovery of the elaboration of floral structure attained by the Mesozoic Cycadophyta before the advent of the Angiosperms themselves.

* "American Fossil Cycads," p. 240.

† The general question of the relation of the early Seed-plants to Ferns is discussed in my article, "On the Present Position of Palæozoic Botany," Progressus Rei Botanicæ, Heft 1, 1906.

‡ "American Fossil Cycads," p. 143.

IV.—*Mycetozoa. Cornuvia Serpula, a Species new to Britain.*

By Jos. M. Coon.

(*Read October* 17, 1906.)

Plates X. and XI.

Among some gatherings of sporangia made towards the end of April 1906, from a heap of spent tan at Grampound, Cornwall, some plasmodicarps of *C. serpula* were found, and submitted to Mr. A. Lister, who, in writing respecting them, says, "It is the first record we have of its being found in Britain." From this and subsequent gatherings, all stages of the organism have been found or cultivated, enabling a complete description to be given. Previous descriptions are limited to the mature plasmodicarp and its contents.

Resting Spores.—Beginning with the resting spore (plate X. fig. 1), we find it yellow, spherical, covered with markings or ridges forming a somewhat irregular network, the meshes of which are chiefly pentagonal or hexagonal in shape; these ridges or markings appear to be folds of the spore-walls, formed doubtless under some definite impulse on the shrinking of the spore contents on ripening. Seen in optical section, the spores appear to have a border about 1 μ broad, but this is only an optical effect. The diameter of the spores is from 10–12 μ over the ridges.

Swarm Cells.—About 12 hours after placing some of the spores in water some had hatched, some were emerging from the spore-

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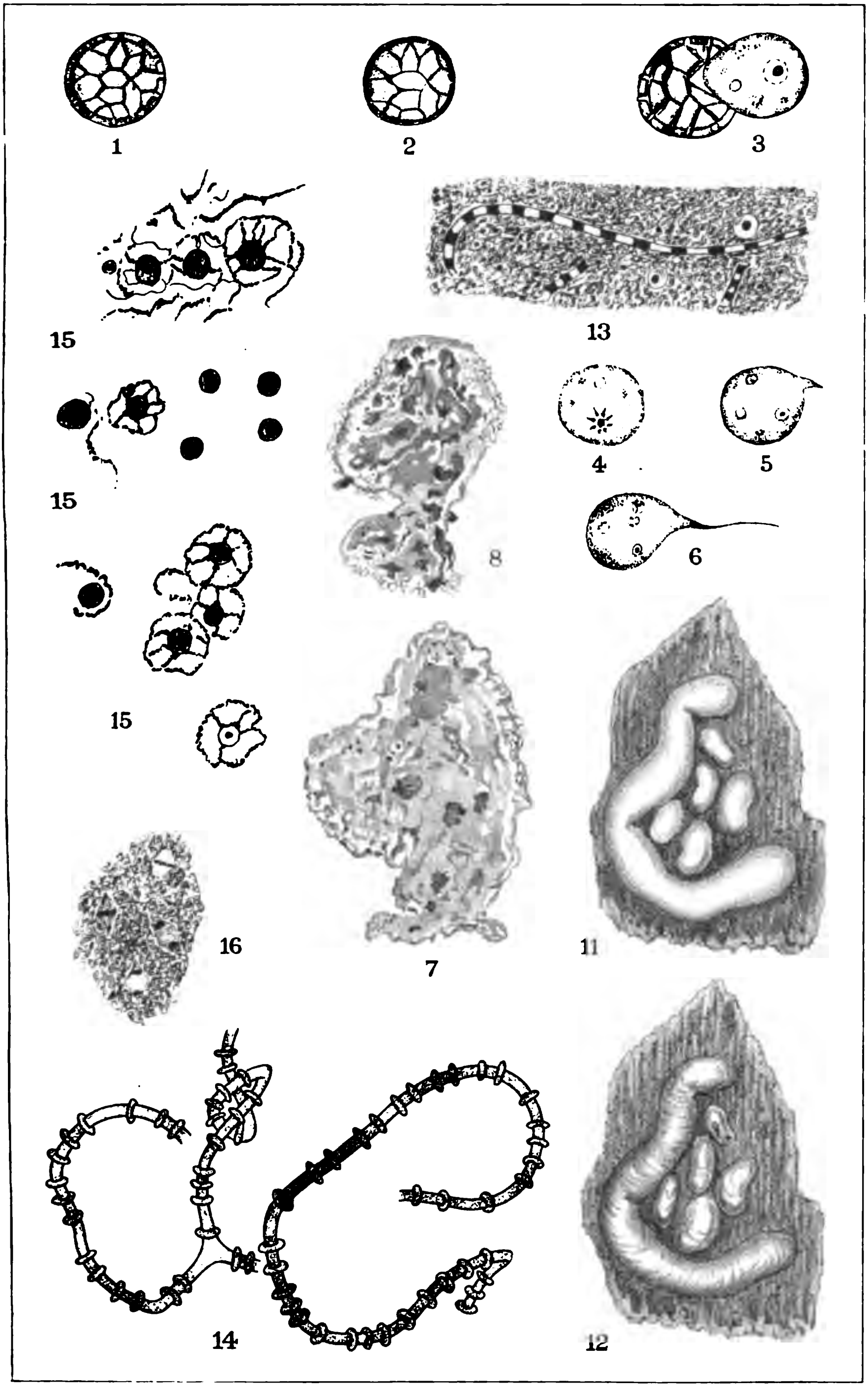
EXPLANATION OF PLATES X. AND XI.

Fig. 1.—Resting spore. × 1200.
„ 2.—Swollen spore. × 1200.
„ 3.—Hatching spore. × 1200.
„ 4.—Swarm cell. × 1200.
„ 5. „ Beak developing. × 1200.
„ 6. „ With flagellum. × 1200.
„ 7.—Plasmodium, only partially extended. × 17.
„ 8.—Sclerotium. × 17.
„ 9.—Plasmodium. Feeding formation. × 19.
„ 10. „ Foraging formation. × 19.
„ 11.—Plasmodicarp. Immature. × 9.
„ 12.— „ Mature. × 9.
„ 13.—Elaters. Forming. × 600.
„ 14. „ Mature. × 520.
„ 15.—Nuclei, with protoplasmic strands connecting with peripheral protoplasm. × 600.
„ 16.—Mitosis. Immature plasmodicarp. × 720.
„ 17 and 18.—Formation of elaters.
„ 19.—Immature cell-wall.



Jos. M. Coon del.

West, Newman lith.

Cornuvia serpula.

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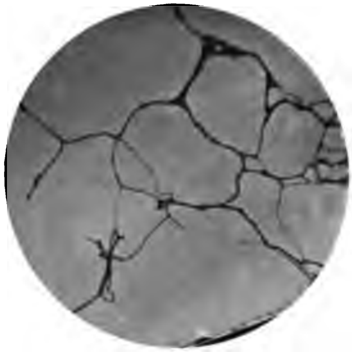

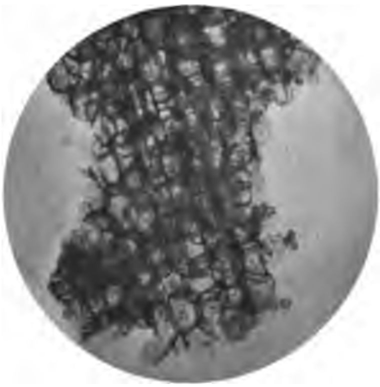

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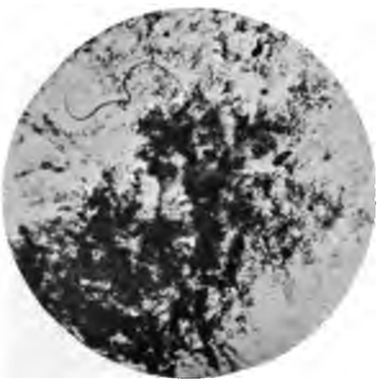

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Cornuvia serpula.

Jos. M. Coon, photo.]

cases, others were swollen but the spore-cases had not ruptured, and others appeared just as when dry.

In the process of hatching, the first visible change in the spores is an apparently swollen condition, with a somewhat translucent aspect; the foldings or markings of the walls become finer, as though they had opened out (fig. 2); subsequently the walls rupture, and very gradually the swarm-cell emerges as a pellucid globule with a visible nucleus (figs. 3 and 4). Slowly the plasma of the swarm-cell assumes a more or less granular appearance, and after a few hours a beak-like projection (fig. 5) extends, which lengthens to a flagellum (fig. 6), forming a propelling organ. By this time one or more vacuoles are visible, and also distributed cloudy masses of protoplasm.

Plasmodium.—The few plasmodia that I have found are very small when compared with those of many genera; from the small and isolated plasmodicarps, they probably do not attain large dimensions.

The first plasmodium found was washed off on to a cover-glass and placed in a damp cell; after a few hours it spread partially (fig. 7), and the streaming movement of the granular protoplasm became visible, the movement being in one direction for 120 seconds, then stopping for 100 seconds, reversing for 120 seconds—these times are not absolute, but averages; the change of position of an advancing edge could not be observed, but by drawing an edge after intervals of time distinct advances were shown. In one case an edge advanced rather more than half a millimetre in 26 minutes. This plasmodium formed a sclerotium (fig. 8) in 12 hours after being placed in the damp cell; seen by transmitted light, it shows a considerable amount of included foreign matter, chiefly small pieces of tan ingested as food; these, with the coloured fluids mixed with its plasma, are cast out or left behind when a plasmodium migrates to a suitable place to pass through the final phase of its life as an individual. In forming the sclerotium considerable condensation of bulk took place.

Another plasmodium, when washed on to glass, extended itself nicely, and photographs are appended; in searching for food, it extends itself in long, thin branching lines (fig. 10), which I describe as the "foraging formation," but when feeding it forms a wide advancing waved edge, followed by its thinly extended and vacuolated substance (fig. 9), in which the streaming movement of the granules are easily and distinctly seen. The true colour of the plasmodium is translucent white, but in its feeding condition it looks cream colour, from the coloured nature of its food, and the fluids stained thereby.

Seen on the tan, the plasmodium is inconspicuous; part may be spread abroad as a finely-laced fan, the bulk of its material lying in a crevice, or imbedded in the tissues of the tan or fine

cracks formed by the crushing mills when the oak bark was broken down.

A stained specimen shows within the hyaline, pellicle-like walls an immense number of granules, some nuclei of various sizes, and some other bodies, the nature of which is not yet determined. These latter stain as deeply as nuclei, but appear to differ from them in many respects.

Plasmodicarp.—When fully fed or otherwise mature the plasmodium aggregates into a semi-globular, extended, or branched mass, in this process extruding the foreign or food-material still ingested, and becomes pure waxy-white (fig. 11); this final form is taken rapidly, and, except for shrinkage on ripening, determines the shape of the plasmodicarp.

In my cultivations the time occupied in this change is about four or five days—for little over two days the colour remains white, then a tint of yellow, which gradually deepens to a golden yellow, the shining surface of the immature white plasmodium becoming somewhat wrinkled and pitted at maturity (fig. 12). I find that the change of colour is an indication that at least some part of the plasma has formed spores—as these ripen the colour deepens. The white inclosing membrane of the young plasmodicarp is surprisingly tough, the yellow wall when mature comparatively brittle; it is two layers thick, the outer easily ruptured, the inner thin, membranous, and cellular; the photograph (No. 19), part of the wall of a mature plasmodicarp, shows what was a revelation to me, as to the extent cell-formation takes place in the Mycetozoa. Fig. 15 is from material from an immature plasmodicarp immediately before formation of spores, the strands of protoplasm connecting the nucleus with the peripheral parts, indicating a very active condition of the cell contents. In another part of the same preparation nuclear division by mitosis is taking place; the stages shown are found in one field of a $\frac{1}{10}$ objective (fig. 16).

Contents of Plasmodicarp.—The plasmodicarp walls inclose a large number of spores, a capillitium in the form of elaters, and some unused material, as apparently a waste or redundant product.

Elaters.—The elaters (fig. 14) are yellow, branched, curved, and tube-like, with ring thickenings at irregular distances. Strasburger* has determined that in *Trichia fallax* the elaters are formed by the aggregation of a number of very minute microsomes; a smear preparation of *C. serpula* shows a similar mode of formation of its elaters. It is assumed that the function of the elaters is to assist in the rupture of the walls, and in the distribution of the spores; the diameter of the tubular part being about 3 μ, and of the ring enlargements about 4–5 μ. The elaters arise in the plasma as elongated, branching threads (fig. 17), having the appearance in

* Bot. Zeit., xlii. (1884) p. 305.

a stained preparation of alternate, clear, and dark spaces, probably indicating clear and filled parts (figs. 13, 17 and 18).

Habitat.—*C. serpula* has only been recorded as found on spent tan which has for some time lain in a heap.

Habits.—Just before changing from plasmodium to sporangia, most of the Mycetozoa migrate from interior or damp positions to surfaces or dry elevated stations, and this is the case with the other genera of the Trichiaceæ; with *C. serpula*, however, this is not so, as I have uniformly found it some inches from the surface in wet or at least damp tan. In a cultivation in my laboratory, a considerable portion of the plasmodium moved from the damp tan to the bottom of the Petri dish, and formed its plasmodicarp in a partly submerged state. I have thought that this may account for the comparative rarity of the species, as its spores will have small chance of distribution by the wind under such circumstances.

Methods.

Spores can be satisfactorily mounted in glycerin jelly.

Swarm-cells: I have had only small experience; I recommend Mr. Rousselet's method for Infusoria.

Plasmodium: Small pieces placed in water will often extend in, say, a few hours; kill in Flemming's fluid, wash, and stain in Heidenhain's iron-alum-hæmatoxylin; if special nuclear staining be desired, bleach by Mayer's method after fixing and passing through upgraded alcohols to 70 p.c.; then stain for, say, 48 hours in each solution, i.e. 48 hours in the iron-alum and 48 hours in the hæmatoxylin; differentiate until nuclei only are stained; control under Microscope.

Smears may be treated as plasmodium; remove any lumps which would prevent the cover-glass sitting down well on thin portions.

Plasmodicarps: Mount in dry cells.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Artificial Parthenogenesis.‡—Yves Delage publishes some notes on a year's experimentation with the ova of *Paracentrotus* (*Strongylocentrotus*) *lividus*.

Certain substances, toxic in large or medium doses, are, in weak doses, efficacious in assisting the fluids usually employed in bringing about artificial parthenogenesis. Among these fluids, Delage has given preference to one with the following composition:—NaCl, solution $2 \cdot 5\ n$, $37 \cdot 5$ parts; sea-water, molecular concentration ($= 0 \cdot 52\ n$) $2 \cdot 5$ parts; water, 60 parts. The efficacy of this is greatly increased by an addition of 5–10 drops per 100 c.cm. of a normal solution of hyposulphite of sodium. Now, if there be added to this a minimal quantity of chloride of manganese, cobalt, or nickel, the parthenogenetic efficacy is greatly augmented.

There are marked individual differences in the susceptibility of ova, even from the same ovary, and this susceptibility seems to be different in relation to the different reagents, e.g. of nickel and cobalt.

As to the viability of the parthenogenetic larvæ, some progress has been made. Many larvæ became plutei. Five showed traces of the young sea-urchin, and in one case the young sea-urchin showed terminal tentacles and two pedicellariæ. The countless plutei resulting from normal fertilisation had all died, though reared in identical conditions, before such an advanced stage was reached.

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Comptes Rendus, cxliii. (1906) pp. 863–5.

Significance of Sperm-bundles.*—E. Bugnion and N. Popoff point out that a sperm-bundle (spermatoblast) results from the proliferation of a single initial cell, which has itself arisen from the division of a primitive germ-cell. This proliferation, which proceeds in regular geometrical progression, leads to the production of a definite number of elements in each bundle—a number typical for the species, or, it may be, to a multiple of this number. Each bundle is associated with a cytophore, or nutritive cell, which secures the coherence of the elements, supports them, and nourishes them. The nutritive cell arises from the germinal epithelium, but the differentiation of this cell, separated at an early stage from the corresponding spermatic cell, does not affect the typical number of elements in the bundle. The initial spermatic cell corresponds to a primordial ovum, and the nutritive cell to an epithelial cell of the ovarian follicle.

Fasciculation of Spermatozoa.†—G. Loisel continues his investigation of the fasciculation of spermatozoa in the testes. He has studied the subject in mammals, birds, reptiles, and amphibians. It appears that the orientation of the spermatozoa is due to the secretion of glandular cells in the parietal layer of the seminiferous epithelium, and of Sertoli's cells in particular. There is a marked chemotactic influence. There may also be (1) a mutual influence among the spermatozoa themselves; (2) an influence due to agglutinating substances; and in some cases (3) a mechanical influence of pressure.

Influence of Molluscan Spermatozoa on Ova of Sea Urchins.‡—Hans Kupelweiser finds that the ova of *Strongylocentrotus purpuratus* and *S. franziscanus* can be made to develop if treated with spermatozoa of *Mytilus*. Sometimes 50 p.c., sometimes 70 p.c. of the eggs "developed." They formed no membrane, but segmented like those illustrating artificial parthenogenesis. In some cases gastrulæ with mesenchyme cells were formed. When more concentrated sperm-fluid was used, the eggs formed a membrane. Even with dead sperms or filtrate of sperms, a membrane was formed, but only in about a fifth of the sea-urchin ova. After a membrane had been formed the eggs did not develop when exposed to mussel spermatozoa. It seems that the sperms must come into actual contact with the ovum. In some cases, the experimenter found a spermatozoon or several within the ovum, and the two nuclei surrounded by a common radiation. Confirmation by other observers will be looked for with interest.

Gastrulation in General and in Mammals in Particular.§—A. C. F. Eternod gives an account of the gastrula stage in representative types, and discusses the question of gastrulation in Mammals. He maintains that in man, as in all "deutolecithal" vertebrates, the embryo appears at the expense of the dorsal portion of a primitive gastrula, which subsequently forms by successive budding a linear series of secondary gastrulæ, giving origin to the metameres.

* Arch. Sci. Phys. Nat., xxii. (1906) pp. 497–500.
† Journ. de l'Anat. Physiol., xlii. (1906) pp. 541–66 (2 pls. and 9 figs.).
‡ Biol. Centralbl., xxvi. (1906) pp. 744–8.
§ Bull. Soc. Vaudoise Sci. Nat., xlii. (1906) pp. 197–224 (6 pls. and 16 figs.).

Blastodermic Vesicle of Mammals.* — G. Schlater sums up his conclusions in the following propositions.

1. The ova of Sauropsida, Placentals, Monotremes, Marsupials, and Amphibians have evolved quite independently from large Piscine eggs, rich in yolk, with partial unequal segmentation.

2. All these main types of ova were simultaneously represented among the primitive terrestrial Vertebrates, the Protamniota.

3. All the Protamniote types of ovum show at the end of the segmentation a differentiation of an external cell-layer, which takes no further share in forming the embryo, but effects connection with the mother (Hubrecht's trophoblast).

4. In Amphibians and Sauropsida the trophoblast comes to nothing, and is even rudimentary. In Mammals only does it attain full development. It is the main factor in forming the placenta.

5. The blastodermic vesicle of Placentals is formed at the end of the Morula stage, the trophoblast exhibiting superficial expansion, the embryonic streak or primordium lagging behind as to growth, and fluid accumulating between the two. The formation of the blastodermic vesicle is a very ancient and primitive process.

6. In its earliest phases the blastodermic vesicle may have had two independent modes of development. A very rapid active penetration of the trophoblast into the maternal mucous membrane, and a very early vascularisation, may have resulted in a quite small blastodermic vesicle, while a loose superficial connection, and a late vascularisation, may have led to a large blastodermic vesicle. Between these two types there are transitional types. The Primates illustrate the first type.

Structure of Early Human Embryo.†—E. Bonnot and R. Seevers describe an embryo of 11 mm., supposed to be about thirty-three days old. Some facts of special interest may be quoted. The heart is relatively six times as large (in volume) as in the new born, and more than seven times as large as in the adult. The volume of the spinal cord is about forty-four times as large, relatively, as in the new born, and 115 times as large as in the adult. Certain important features in the blood-vessels are noted. The dorsal aorta is formed by the union of the two lateral aortic arches, just below the origin of the subclavian (vertebral) arteries. At its origin it is comparatively narrow, but gradually enlarges until its diameter is at least twice as great towards its lower end. A branch from the vitelline vein extends into the mesentery, and evidently represents the superior mesenteric vein of the adult. The vitelline vein, distal to the duodenum, shows signs of involution; that it does not persist as the superior mesenteric vein, has evidently been overlooked by many later writers.

Development of Ornithorhynchus.‡—J. T. Wilson and J. P. Hill give an abstract of the results of their investigations upon the intra-uterine development of the egg of *Ornithorhynchus*. One or two points of special interest may be specified. There is a very early differentia-

* Anat. Anzeig., xxx. (1907) pp. 8–19 (1 fig.).
† Op. cit,, xxix. (1906) pp. 452–9 (3 figs.).
‡ Proc. Roy. Soc., Series B, lxxviii. (1906) pp. 313–15.

tion of the layer of yolk entoderm surrounding the yolk-mass of the monotreme egg. The primitive streak is originally entirely independent of the primitive knot and its "gastrulation-cavity"; there is a subsequent intimate approximation of these structures. There is well-marked neuromeric segmentation of the cephalic region of the flattened medullary plate, a clear differentiation of early plate-like ganglionic expansions of the neural crest in the cephalic region, and various cellular connections between the cephalic ganglionic plates and certain of the neuromeric segments of the medullary plate. The "archencephalic" subdivision of the cephalic portion of the medullary plate, from which the fore brain and most, if not all, of the mid brain are derived, is relatively insignificant.

Embryonic History of Carotid Arteries in Chick.*—G. H. Twining finds that the branches of the external carotid when first established are derived exclusively from the ventral carotid. This condition is seen in embryos incubated for 4½ days; it persists until the middle of the fifth day, at which time a spur is developed from the dorsal vessel which, gradually becoming larger, forms an anastomosis with the ventral vessel, so that by the sixth day the blood supplying the upper and lower jaw is derived from two sources. The dorsal branch grows larger, while the ventral carotid atrophies in its middle portion. The development of the carotid arteries in birds is very similar to the development in reptiles (Crocodilia); there are also broad resemblances between the process of formation in birds and mammals, with difference in detail.

Origin of the Vertebrate Eye.†—G. Jelgersma argues in support of the view that the simple endoneural eye of the Ascidian larva—which is conceivably derivable from an Invertebrate eye if we think of the neural canal as primitively open—may be taken as the starting point for the evolution of the Vertebrate eye. It is true that the eye of the Ascidian larva has a lens which develops from the tissue of the neural wall, and it is an unpaired eye. But the author seeks to show that these differences do not present serious difficulties in the way of the homology suggested, and he is nothing if not ingenious in making a strong case for his theory.

Eggs of Reptiles.‡—G. Hagmann describes the eggs and the hatching of the eggs in the Brazilian Geckonid, *Gonatodes humeralis*, and in another lizard, *Tupinambis nigropunctatus*. In both cases the eggs are laid in termitaries. He also describes the egg of *Caiman sclerops*, and notes, as an interesting instance of "isolation," that while *C. sclerops* and *C. niger* live together, their sexual periods are separated by four months.

Buccal Glands and Dental Strands in Anura.§—R. Oeder finds that the glandular follicles of the toad arise singly or in groups, in connection with the choanæ and with the palate. In the frog the glandular

* Anat. Anzeig., xxix. (1906) pp. 650–63 (7 figs.).
† Morphol. Jahrb., xxxv. (1906) pp. 377–94 (1 pl.).
‡ Zool. Jahrb., xxiv. (1906) pp. 307–16 (3 pls.).
§ Jen. Zeitschr. Naturw., xli. (1906) pp. 505–48 (2 pls. and 14 figs.).

follicles arise from a ridge-like thickening of the mucous membrane, but in the adult those on the palate predominate over those of the choanæ. In the toothless toad there is a distinct dental strand on the upper jaw. In the frog there is in the development of the dental strand and of the teeth, an adumbration of the state of affairs in Mammals. But we cannot do more than indicate the general nature of the author's investigation.

Suggestions from the Embryology of Fishes.*—J. Graham Kerr discusses the embryology of certain of the lower fishes, and its bearing upon Vertebrate morphology. Perhaps Vertebrate embryology has been too much influenced by deductions from forms (e.g. Selachian and chick) with a large mass of food-yolk.

The process of gastrulation in *Polypterus* is interesting as a transitional condition between that found in *Amphioxus* and that characteristic of Amphibians. In *Lepidosiren* there is a decided advance towards the type of gastrulation found in the Elasmobranchs.

Various considerations make it probable that Vertebrates, Annelids, Arthropods, and Molluscs are offshoots of a common triploblastic stem. On the other hand, various points in the development of Vertebrates, e.g. the apparent traces of a once present slit-like protostoma, forming a continuation of the blastopore forwards along the mid-line of the medullary plate, suggests an actinozoon-like ancestor.

External gills, conspicuous features in the development of Amphibians, of the two existing Crossopterygians, and of two of the three surviving Dipnoans, are probably homologous structures of great antiquity. Their very early appearance, the importance of their blood-supply—the main aortic arch passing into them—and the remarkable constancy of their position in relation to the upper end of the visceral arch, are among the facts which lend importance to these structures.

It is suggested that, if the gill-clefts were, in their first functional stages, clefts (and not pouches), their primary significance may have been in connection with the pumping of water over the external gills. Secondarily, they may have become directly respiratory by a spreading of respiratory ectodermic epithelium along the walls of the clefts.

The homology of the swim-bladder of Crossopterygians and Dipnoans with lungs seems now undeniable. The hydrostatic function of the swim-bladder and the dorsal migration of its connection with the pharynx is probably secondary.

The only paired organs of lower Vertebrates which fulfil the two qualifications of pre-existing structures from which paired limbs might have evolved, viz. projection and muscularity, are the external gills.

In *Polypterus*, *Lepidosiren*, and *Protopterus*, the brain shows at an early stage a division into two regions, the posterior giving rise to the hind brain region of the adult, the other to the whole of the brain anterior to this. The division into "rhombencephalon" and cerebrum is probably primitive. From a study of the same three forms evidence is found supporting the view that the cerebral hemisphere region is primitively paired, and absolutely against the view that the hemispheres

* Proc. Roy. Phys. Soc. Edinburgh, xvi. (1906) pp. 191–215.

are to be looked upon as the terminal region of the brain, as a "telencephalon" in the sense of His.

In *Lepidosiren*, the author finds that the motor nerve can be traced back to an extremely early stage of development, when it is found in the form of a soft protoplasmic bridge connecting spinal cord and myotome, which are still in contact. As development proceeds, the myotome becomes pushed outwards by the development of mesenchyme, and the nerve-trunk becomes correspondingly lengthened. The author also discusses the development of the primitive nerve fibrils, the genetic affinities of the lower Gnathostomata, the cellular constitution of the Vertebrate body. The primitive cell-layers—ectoderm and endoderm—may be thought of as consisting primarily of an epithelial layer of tailed cells (as seen in *Lepidosiren* ectoderm). Parts of the primitive endoderm become nipped off to form cœlomic lining (including the myocœlic wall, which becomes partially converted into muscle), while individual cells of both primary layers migrate into the cavity between them, and give rise to the mesenchyme and its derivatives. In the nipped-off parts of primitive endoderm which line the enterocœlic outgrowths, we may see persisting representatives of the cœlenteric pouches of the Scyphozoon cœlenterate, and in the immigration of mesenchyme cells a continuation of the similar process so beautifully seen in the immigration of the skeletogenous cells of Alcyonaria.

Optic Chiasma of Teleosts.*—A. P. Larrabee has studied the dimorphism in the relation of the optic nerves where they cross in Teleosts. The right nerve (i.e. the nerve to the right eye) may be either dorsal or ventral to the left. He dissected 4950 specimens of *Salvelinus*, and found that 2749 had the right nerve dorsal, and 2201 the left nerve dorsal. He dissected 1132 specimens of *Gadus*, and found that 580 had the right nerve dorsal, and 552 the left nerve. There is thus a slight excess of right. The dimorphism is not inherited; it is not due to an earlier development of one of the nerves; gravity has no effect on the nature of the crossing; Mendelian principles do not apply; Galton's law is likewise inapplicable. The condition of the crossing is a matter of chance.

W. E. Castle adds in a note that it is somewhat remarkable that the rights should uniformly predominate. The case may perhaps belong to the same category as the more frequent occurrence of polydactylism in guinea-pigs upon the left side of the body.

Development of Tentacular Duct of Xenopus.†—L. Cohn, continuing his investigation of the tentacular apparatus of *Xenopus calcaratus*, finds that the tentacular duct, like the two tentacular ducts in *Ichthyophis glutinosa*, arises from an epithelial ridge constricted off from the epidermis and sunk inwards. It is quite independent of the nasal primordium, though it becomes secondarily connected with it.

Origin of Mesenchyme in Sturgeon.‡—S. Tikhenko notes that embryologists are divided into two camps in regard to the origin of the

* Proc. Amer. Acad. Arts and Science, xlii. (1906) pp. 217–31.
† Zool. Anzeig, xxxi. (1906) pp. 45–53 (7 figs.).
‡ Op. cit., xxx. (1906) pp. 728–30 (2 figs.).

mesenchyme. He therefore submits a case—the development of the maxillary teeth in *Acipenser ruthenus*—where it seems quite clear that the ectoderm gives origin to the mesenchyme.

Deformity of Head in Abramis vimba.*—E. Leonhardt has studied the peculiar deformity known as "Mopskopf." It is known in carp, pike, trout, salmon, bullhead, and other fishes. It appears to be induced by a displacement of the embryo within the egg-envelope, in consequence of which there is unequal pressure on the part of the envelope on the body of the embryo.

b. Histology.

Blood of the Fowl.†—W. Rosenthal has studied this with the highest powers and with the ultra-microscope. The mature erythrocytes consist of the nucleus; the endosome, soluble in water, and containing the hæmoglobin; and the envelope, insoluble in water. The envelope is probably viscid; it is limited externally by a precipitate-membrane. From its substance extremely delicate smooth flexible filaments may be seen to arise, such as were seen also in the blood of the mouse.

Alleged Artificial Cells.‡—Gaston Bonnier points out that Leduc's artificial cells correspond to the curious precipitates elaborately studied by Traube from 1865 onwards, and to the arborescences described by Pfeffer (1877) and others. The form of the precipitate is a function of the medium in which it develops and, to a certain extent, of the form of the vessel containing the solution. There is nothing new in Leduc's results except his assertion that his artificial cells—tubular metallic precipitates—have a cellular structure and most of the functions of life except reproduction.

Epithelial Corpuscles in Mammals.§—J. Erdheim has studied the glandulæ parathyroideæ, or epithelial corpuscles, in the rat, rabbit, and hedgehog, and finds that there is a normal occurrence of accessory epithelial corpuscles—sometimes seven (rat), nine (rabbit), or five (hedgehog).

"Minute Spaces" in the Body.‖—P. Schiefferdecker argues for the probability of the existence of ultra-microscopic spaces in the tissues, which, in spite of their minuteness, are of significance in the nourishment of tissue. There are such spaces in connective, nerve, and bone tissue. The author assumes a fluid stream carrying nutritive substances from the blood-vessels through these channels.

Action of Anæsthetics on Living Tissue.¶—N. H. Alcock has made numerous experiments on the action of anæsthetics on living tissues. He finds that chloroform breaks down a semi-permeable

* Zool. Anzeig., xxxi. (1906) pp. 53–60 (2 figs.).
† Biol. Centralbl., xxvi. (1906) pp. 697–720.
‡ Comptes Rendus, cxliv. (1907) pp. 55–8.
§ Anat. Anzeig., xxix. (1906) pp. 609–23 (5 figs.).
‖ Arch. Mikr. Anat., lxix. (1906) pp. 439–55.
¶ Proc. Roy. Soc. London, Series B, lxxviii. (1906) No. B 523, pp. 159–69 (5 figs.)

apparatus, and believes that this is the characteristic action of an anæsthetic on living tissue.

Zoological Technique.*—Michael F. Guyer has prepared a handbook giving practical directions for the preparation of zoological material for microscopic work. He discusses histological methods, fixing, staining, cutting, mounting, decalcification, maceration, injection, and special devices, e.g. for embryological work.

Relation of Liver-cells to Blood-vessels and Lymphatics.†—P. T. Herring and Sutherland Simpson have investigated the question of the relationship of the blood and lymph to the liver-cells in mammals. They find that the liver-cells are permeated by fine anastomosing channels which undoubtedly receive plasma from the blood. The lymphatics of the liver (dog, cat) are confined to the visible connective tissue of Glisson's capsule and the adventitia of the hepatic veins. There are no lymphatics within the lobules. The endothelium lining the intra-lobular blood spaces is incomplete, and allows the passage through it of both fluid and fine solid particles into the liver-cells. The concentrated character of the liver lymph is explained by this feature of the endothelium lining the intra-lobular blood-vessels, which thus permits the plasma to pass directly into the liver-cells. It is possible that the cells of the lobule form a syncytium, and the lymph is thus able to pass from cell to cell.

Mechanism of Destruction of Nerve-cells.‡—Y. Manouélian communicates facts showing clearly that in human madness there is phagocytosis of the nerve-cells of the cerebro-spinal ganglia. This is effected by the macrophages, the results being analogous to those accompanying senile degeneration. All stages of phagocytosis were observed. The macrophages penetrate the nerve-cells, attack the pigment, break up and absorb the granules; it is probable that the other parts of the nerve-cell also become their prey.

Eye of Notoryctes typhlops, Stirling.§—Georgina Sweet has made a study of this structure. She finds that in all its parts it is much more degenerate than is the eye of *Talpa* or *Scalops*, its analogous forms in other parts of the world. It has retired far beneath the skin, which passes over it unaltered, but for the presence of tactile (?) organs. A conjunctival sac is present, and the lachrymal glands are extremely well developed—both being concerned with some function unconnected with vision. The eye muscles are abnormal and variable; their usual nerve supply is absent. Sclerotic, cornea, and choroid are indistinguishable from each other; the lens is always absent, the vitreous body practically so. The other parts are very degenerate or absent. The relation of this marked degeneration to the environment is considered in the paper.

* Animal Micrology: Practical Exercises in Microscopical Methods. University of Chicago Press, 1906, ix. and 240 pp.
† Proc. Roy. Soc., Series B, lxxviii. (1906) pp. 455–97 (2 pls.).
‡ Ann. Inst. Pasteur, xx. (1906) pp. 859–68 (1 pl.).
§ Quart. Journ. Micr. Sci., l. (1906) pp. 547–71 (1 pl.).

c. General.

Animal Fats.* — C. Schneider and S. Blumenfeld have made a chemical study of the fats of seals, porpoises, bears, otters, etc. It appears that seals from the coasts have more iodine in their fat than those from the open sea; that the otter has much more iodine in its fat than a terrestrial carnivore like the wild cat; and that, in general, there is more iodine in the superficial fat than in the internal fat.

Volant Adaptation in Vertebrates.† — R. S. Lull concludes that volant adaptation has occurred seventeen times among Vertebrates, ten of which (*Rhacophorus*, *Ptychozoon*, *Draco*, *Petauroides*, *Petaurus*, *Ærobates*, *Anomalurus*, *Pteromys*, *Galeopithecus*, and *Propithecus*) are merely adaptations for more or less prolonged "soaring" leaps, while in seven instances (*Thoracopterus*, *Gigantopterus*, *Exocœtus*, *Dactylopterus*, Pterosaurs, Birds, and Chiroptera) true flight has been developed—a little doubtfully in some cases.

Soaring implies, with but one exception, the development of a fold of skin along the animal's flanks, supported in one instance (*Draco*) by an extension of the ribs beyond the body-wall, but generally stretched between the fore and hind limbs. This fold is often supplemented by others in front of the fore limbs and between the hind limbs, sometimes involving the tail.

True flight always implies a more or less profound modification of the fore limbs, which become, as a consequence, unsuited for ordinary progression. True flight has been developed once in each of the classes of strictly air-breathing animals, and probably at least four times among fishes.

Except in fishes, soaring implies also present or ancestral arboreal adaptations, and this may apply as well to the true fliers. It is certainly true of the bats, possibly true of the birds, but of the Pterodactyls one cannot be certain.

Besides the primary modifications which constitute the machinery of flight, other portions of the body, especially the nervous system, the sensory and nutritive organs, may exhibit secondary volant characteristics. These, like the primary modifications, are in direct proportion to the powers of flight.

The Labyrinth of Mammals and Birds.‡ — A. A. Gray describes this organ in the lion, the Indian gazelle, the three-toed sloth, the kangaroo, the crested screamer, and the ostrich. Some observations are made upon the conditions of the inner ear in Mammals in general. In addition to the peculiar type found in Monotremes, the cochlea occurs in a sharply pointed form, e.g. in Carnivora and Rodents, and in a flattened condition as in man, monkeys, lemurs, Ungulates, and Cetacea. As regards the perilymphatic space, it is usually either very small or completely absent in the canals. Man, monkeys, and the seal are exceptions to this rule. This space does not appear to have any physiological

* Chemiker Zeitung, xxx. (1906) No. 6, 6 pp. See also Zool. Zentralbl., xiii. (1906) p. 702.
† Amer. Naturalist, xl. (1906) pp. 537–66 (14 figs.).
‡ Proc. Roy Soc. London, Series B, lxxviii., No. B 525 (1906) pp. 284–96 (3 pls.)

function. The otoliths of Mammals are usually small, but in the porpoise, seal, and kangaroo this is not the case.

Teeth-formulæ of Platyrrhine and Catarrhine Primates.*—L. Bolk suggests that the catarrhine set of teeth has not originated by an excalation but by a terminal reduction. He is convinced that because m_2 has become M_1, the replacing tooth, which originally belonged to it, namely P_3, no longer appears. In any case, this investigation shows that the differentiation of the entire set of teeth of the Primates is more intricate than was hitherto supposed.

Lachrymal Bone of Ungulates.†—Theodor Knottnerus-Meyer has made an elaborate study of the characters of the lachrymal bone in Hyracoidea, Proboscidea, Perissodactyla, and Artiodactyla, and shows that this may be of great service in determining systematic relationships.

Mandibular Articulation in Monotremes.‡—W. Lubosch has made a comparative study of the mandibular articulation in Mammals, with particular reference to the Monotremes. The characteristic mammalian articulation arose in Triassic ages in an association of dentary and squamosal. As the skull became arched above, the squamosal was displaced downwards, and with this were associated the development of the intertemporal bone and the shunting of the ear, besides modifications of the pterygoid and hard palate. The primitive mucous pocket between the periosteal surfaces of squamosal and dentary was abetted by co-operation on the part of Meckel's cartilage (a bud of which grew in below the dentary to the joint-surface), and perhaps by co-operation of the petrosal, similarly sinking into the squamosal. The periosteum of the joint was modified, the pterygoideus externus was associated therewith. In the Eocene ages there was a marked differentiation. The duckmole is an offshoot from a rodent-like Monotreme stock. The joint-surface was modified; there was a reduction of the loose connective tissue and a regularly arranged modified periosteum, with which the external pterygoid lost its previous connection. From a non-specialised Monotreme condition, the state of affairs in *Echidna* arose. The insertion of a median portion of the external pterygoid in the modified periosteum is of phyletic importance. Gradually a free meniscus was formed.

Preen-Gland of Birds.§—P. Paris gives a useful account of the "uropygal" gland. It is always bilobed, but the lobes may be more or less fused; each lobe has a canal, but the two canals have a common aperture. Its occurrence is rather difficult to interpret, for it is absent in some birds and present in their near relatives. It is usually best developed in birds which frequent water, but while it is large in the white stork, it is small in the herons. Kossmann's conclusion that the excretory papilla is adapted to the form of its possessor's beak, is not well borne out by the facts.

Three types are distinguished:—(1) With lobes coalesced, with a

* Proc. Section of Sciences Acad. Amsterdam, viii. (1906) pp. 781–93.
† Arch. Naturges., lxxiii. (1907) pp. 1–152 (5 pls. and 34 figs.).
‡ Jen. Zeitschr. Naturw., xli. (1906) pp. 549–606 (4 pls. and 5 figs.).
§ Bull. Soc. Zool. France, xxxi. (1906) pp. 101–7 (24 figs.).

strong reservoir, a globular excretory nipple, with delicate walls, without a terminal tuft of down, e.g. in the sparrow, blackbird, rook. (2) With distinct lobes, with a strong reservoir, a long delicate excretory nipple, and a feebly developed terminal tuft of down, e.g. woodpecker. (3) With distinct lobes, without a reservoir, with a short excretory nipple, truncated, with thick muscular walls, and a strong terminal tuft of down, e.g. in the stork, heron, flamingo, cormorant.

In Ratitæ it is present in the embryos; it persists (naked) in the kiwi; its presence in the emu is asserted by Orlandi, but denied by Nitzsch. It is absent in certain (American) parrots, in the bustard, in *Tetrax campestris*, and in the fantail pigeon.

The fatty secretion varies in colour, contains no excretory products, and has a characteristic odour. Removal of the gland in starlings, wild duck, etc., was not followed by any change in the state of the plumage. Obstruction of the canals, e.g. in the fowl, seemed to make no difference. Its importance as supplying a lubricant or varnish for the feathers seems to have been much exaggerated. Its function in many cases seems to be of little or no importance.

Skeleton of Goniopholis crassidens.*—R. W. Hooley describes the skull and the greater portion of the skeleton of this Crocodilian from the Isle of Wight. The vertical elevation of the orbits is much more accentuated than in the Telosaurs or other Amphicœlians, and very far removed from the everted orbits of the Procœlians. Their direct frontal aspect curtailed the arc of vision, and it would seem that the creature's prey, or foes, were in an unobserved position when behind the orbits. Considering the massiveness of the head, and the weight which its heavy armour must have given to the body, the length and slenderness of the mandibles are remarkable. It is surprising how they withstood the strain occasioned in combat or in capture. The animal was capable of a gape of over a metre. The presence of the interorbital keel, found in all the American alligators, is probably the developed trait peculiar to a line descended from the Goniopholidæ.

Colour Variations in Rana temporaria.†—C. B. Klunzinger describes the varieties (*a*) known as *obtusiformis* Fatio, with a blunt snout (with colour variations *rubriventris*, *flaviventris*, *viridis*, and *reichenbachensis*); (*b*) designated *acutirostris* (with colour variations on similar lines). He discusses the tendency to melanism in frogs, which he associates with the dark deposits in pools rich in humic acid.

Red Variety of Salamandra maculosa.‡ — Elise Melitta von Schweizerbarth found in a brook near Stuttgart a black-red salamander. Its young were practically normal in coloration. Haeckel found a similar red variety in 1852.

Structure of a Cave Salamander.§—Ellen Tucker Emerson describes *Typhlomolge rathbuni* Stejneger, a blind cave salamander, discovered in

* Quart. Journ. Geol. Soc., lxiii. (1907) pp. 50–63 (3 pls.).
† Ber. Senckenberg Nat. Ges., 1906, pp. 105–15 (2 col. pls. and 16 figs.).
‡ Tom. cit., pp. 119–21 (1 col. fig.).
§ Proc. Boston Soc. Nat. Hist., xxxii. (1905) pp. 43–76 (5 pls.).

1894, when a dozen or more specimens were thrown up from an artesian well 188 feet deep, bored by the United States Fish Commission, at San Marcos, Texas. The author supplements Dr. Stejneger's preliminary description of this interesting form. The most striking characteristics which Stejneger noticed, are the small, functionless, subcutaneous eyes; the white slightly iridescent skin, reminding one of the integument of *Proteus*; the extreme length and slenderness of the limbs; and the great size of the head as compared with that of the body.

It is pointed out that *Typhlomolge* in most of its structural peculiarities (described in detail) shows a marked resemblance to the *Spelerpes* larva. The resemblances to *Proteus* are probably due to similar surroundings and manner of life. It seems, therefore, that *Typhlomolge* should be classed with *Spelerpes* in the family Salamandridæ, and the subfamily Plethodontinæ.

The persistence of the gills and the retention of other larval characteristics, after the animal is sexually mature, is a phenomenon of rather frequent occurrence among the Urodela (such cases have been reported in *Triton vulgaris*, *T. alpestris*, *T. cristatus*, *T. boscai*, *T. waltli*, and *Amblystoma*). According to Gadow, this may be interpreted as the result of adaptation to the surroundings, which make a retention of larval features advantageous, or as the result of the retardative or inhibitory influence of the environment. "It may be possible that *Typhlomolge* is a form closely akin to *Spelerpes*, whose retention of larval characteristics, although sexually mature, is a result of its environment, and that in other surroundings it might, as was the case with the Axolotl, undergo metamorphosis."

Circulatory and Respiratory Systems in Desmognathus fusca.* Anne B. Seelye gives an account of these systems in this lungless salamander. Both microscopic and macroscopic investigations are recorded. This animal is furnished with an important breathing organ in the form of a capillary network in the anterior portion of the alimentary canal, mouth, pharynx, and œsophagus. This skin also plays an important part in respiration. The integument around the sides of the neck, where the skin is free from the underlying muscles, is especially rich in subcutaneous vessels.

Gill-filters of Deep-sea Fishes.†—Enoch Zander has studied the branchial filters in 14 species of deep-sea fishes, e.g. of *Cyclothone*, *Stomias*, *Macrurus*, and *Neobythites*. His results harmonise with those reached in his previous more general survey of Teleosteans. There is considerable variety, but the specific differences are less striking than in surface forms, probably because the conditions are more uniform. In two species the sieve-processes are absent. The other species illustrate the three characteristic main types of filter, but the framework is never very close. A difference between those which probably live and feed at the bottom and those that are pelagic can be established with some security.

* Proc. Boston Soc. Nat. Hist., xxxii. (1905) pp. 335–57 (4 pls.).
† Zeitschr. wiss. Zool., lxxxv. (1906) pp. 157–82 (1 pl., 17 figs., and 2 tables).

Species of Gadus.*—H. C. Williamson has studied the specific characters of the three smallest species of *Gadus*, viz. *G. luscus*, *G. minutus*, and *G. esmarkii*, and gives a carefully worked out comparison, dealing with the dimensions, the number of fin-rays and vertebræ, the skulls, the reproduction, etc. He makes it very clear that the sum or resultant of the characters is the only sure basis for diagnosis. There is hardly a single character that can be absolutely depended on. A key to six species (*G. callarias*, *G. virens*, *G. pollachius*, and the three named above) is given.

Hermaphroditism in Cod.†—H. C. Williamson reports on two cases of hermaphroditism in *Gadus callarias*. In one case the fully developed female gonads bore a small testis at the anterior end of each ovary; in the other a single ovary on the right side was associated with a full-sized testis on the left. In the first case the roe was nearly ripe, the testis was considerably short of being ripe. It is conceivable that after the eggs are discharged, the ovary may function as a vas deferens. In a hermaphrodite ling, described by H. M. Kyle, the ovary seemed to function as a vas deferens and the oviduct for the issue of both eggs and sperms.

Plankton Studies.‡—Angelo Senna gives a preliminary account of the plankton collections made by the 'Liguria' in its circumnavigation of the globe (1903–5), under the command of His Highness the Duke of the Abruzzi.

Some Vertebrate Abnormalities.§—W. M. Smallwood reports a number of abnormalities. In a female cat a double condition of the post-caval vein extended from the union of the common iliacs to the kidneys. This might be due to a persistence of the posterior cardinals in this region. Another case was the persistence of the foramen ovale between the auricles of a pigeon. In *Necturus*, a broad, short branch of the splenic vein passed directly to the body wall where a number of short, finger-like branches extended in all directions for a short distance. Two cases of double spleen in *Necturus* are noted.

Reptilian Freaks from Indiana.‖—W. S. Blatchley describes four two-headed snakes, one two-headed turtle, and (*pace* the title) one five-legged frog, and one two-tailed salamander.

Abnormalities in Fishes.¶—James Johnstone describes an example of *Raia clavata* which exhibited an arrested development of the pectoral fins so that the head remained free from them. An account is also given of a flounder, *Pleuronestes flesus*, which was pigmented on both sides. It was further abnormal in that the left eye is situated on the (secondary) dorsal margin of the head, being easily visible from the "blind" side. The coincidence of these two more or less larval conditions in an adult is noteworthy.

* Twenty-fourth Annual Report Fishery Board for Scotland, 1905 (1906) pp. 116-58 (3 pls.). † Tom. cit., pp. 290–2 (2 pls.).

‡ Raccolte Planctoniche (R. Ist. Stud. Sup. Firenze) i. (1906) pp. 1–49 (1 pl. and 1 map). § Anat. Anzeig., xxix. (1906) pp. 460–2 (4 figs.).

‖ Proc. Acad. Nat. Sci. Philadelphia, 1906, pp. 419-22.

¶ Proc. and Trans. Liverpool Biol. Soc., xx. (1906) pp. 330–5 (2 figs.).

Tunicata.

Salpa and the Phylogeny of the Vertebrate Eye.*—M. M. Metcalf criticises the views expressed by various writers on this subject. One important error behind all attempts hitherto made to establish a relationship is the failure to realise that *Salpa* has apparently been derived from a sessile ancestor somewhat like the adult Ascidian, and not from a form like *Appendicularia*. Nearly all the features of the anatomy of *Salpa* point to this conclusion, and none more clearly than the condition and development of its central nervous system. To one familiar with the development of the eye of *Salpa*, any phylogenetic significance such as has been suggested, seems impossible.

New Salpoid from Japan.†—W. E. Ritter describes *Cyclosalpa retracta* sp. n. The body is cylindrical, slightly smaller at the posterior end, with a median ventral prominence into which the digestive tract protrudes. The test is thin and transparent, the length is 7·5 cm., both orifices are terminal. A straight intestine links this form to *Cyclosalpa*. There are 16 muscle bands, more than in any other known *Salpa*, except *S. tilesii-costata* (18–20). But the most interesting thing about the muscles is the fact that many of the bands are continuous around the entire body—a fact which detracts considerably from the value of the distinction between the Doliolidæ (Cyclomyaria) and the Salpidæ (Hemimyaria).

British Tunicata.‡—The second volume of the unfinished monograph on British Tunicata by the late Joshua Alder and the late Albany Hancock, edited by John Hopkinson, deals with the genera *Ciona* and *Corella* in the family Ascidiadæ, and with the families Molgulidæ, Cynthiadæ, and Clavelinidæ.

Japanese Ascidians.§—R. Hartmeyer describes a number of new species, *Molgula japonica*, *Halocynthia comma*, six species of *Styela*, two species of *Polycarpa*, two species of *Ascidia*, and *Chelyosoma dofleini*.

Asajiro Oka ‖ describes nine species of *Halocynthia*, of which six are new; also *Microcosmus hartmeyeri* sp. n., *Styela kroboja* sp. n., and *Chelyosoma siboja* sp. n.

INVERTEBRATA.

Mollusca.

a. Cephalopoda.

Opisthoteuthis depressa.¶—W. T. Meyer gives an anatomical description of this remarkable cuttlefish, belonging to the interesting family Cirroteuthidæ, which have peculiar, thin, thread-like processes in two rows on the arms to right and left of the suckers, and are also well

* Anat Anzeig., xxix. (1906) pp. 526–8.
† Annot. Zool. Japon, vi. (1906) pp. 1–5 (2 figs.).
‡ Ray Society, London, 1907, xxviii. and 164 pp., pls. 21–50.
§ Zool. Anzeig., xxxi. (1906) pp. 1–30 (12 figs.).
‖ Annot. Zool. Japon, vi. (1906) pp. 37–52.
¶ Zeitschr. wiss. Zool., lxxxv. (1906) pp. 183–269 (6 pls. and 16 figs.).

marked by the absence of radula and ink-sac. The genus *Opisthoteuthis* is adapted to life on the sea-floor; the species *Opisthoteuthis depressa* (Ijima and Ikeda) occurs off Japanese coasts (150 metres). In structure there is evidently affinity with Octopods, but, besides the absence of radula and ink-sac, there are peculiarities in the highly-developed fins, in the fusion of funnel and mantle, in the presence of cirri, and in the structure of the male gonads. There is also marked reduction of the viscero-pericardial cavity, leading to the almost complete disappearance of the right water-vessel; the right oviduct is absent, and the cerebral ganglia are more concentrated than in *Octopus*. The Cirroteuthidæ may be regarded, as Brock maintained, as a divergent offshoot from the Octopods.

γ. Gastropoda.

Nervous System of Gastropods.*—B. Aeberhardt has made a comparative study of the nervous system of Gastropods, with special reference to the difficult question of asymmetry. He starts with a primitive form like *Paludina*, then discusses *Pomatia septemspiralis*, also not greatly modified, then *Cyclostoma elegans*, then the much more specialised *Bithinia tentaculata*, and so on to *Helix* and other Pulmonates.

Odontophore of Sycotypus canaliculatus.†—J. C. Herrick explains the *modus operandi* of this Gastropod in boring through the shells of oysters and clams and in rasping out their contents. The apparatus is highly complex; the mechanism of the radula was rightly compared by Huxley to a chain-saw, with the restriction that the sawing occurs only on the return draw. The relations of buccal cartilage, radula, andradula-sac, with their musculature, are explained. The nerve supply of these parts has also in large part been determined.

Arterial System of Aplysia.‡—M. Blatin and F. Vlès give precise details of the arterial system of *Aplysia punctata*. The heart, consisting of ventricle and bulb, gives rise to an aorta in front, a visceral artery behind, and a stomach artery to the left. The branches of these vessels are described and clearly figured. Torsion is apparent in the arterial system; the aorta is thrown to the right of the sagittal plane, as is the visceral commissure, to which it appears to be attached; the pallio-pedal and cephalic branches of the right side show in their earlier origins similar evidence of twisting.

δ. Lamellibranchiata.

Giant Scallop.§—G. A. Drew gives an account of the habits structure, and development of the giant scallop (*Pecten tenuicostatus* Mighels). The shell is well adapted for rapid movement. The mechanism of swimming is described. There is a large byssal gland. It seems probable that one loop of the intestine has been overlooked in previous dissections of scallops. The labial palps are peculiarly ruffled above and below the mouth. A special arrangement makes it possible

* MT. Nat. Ges. Bern, 1905, pp. 112-32 (18 figs.).
† Amer. Naturalist, xl. (1906) pp. 707-37 (16 figs.).
‡ Arch. Zool. Expér., Notes et Revue, No. 4, xxxv. (1906) pp. xc.-cii. (10 figs.).
§ Studies Univ. Maine, No. 6 (1906) pp. 1-71 (17 pls.).

for water to be forcibly ejected from the shell in swimming without injuring the gills. The large size of the animal (7 inches in length) makes it possible to inject the vascular system successfully. The visceral ganglia are very large and complicated. The circumpallial nerves and the branchial nerves have ganglion-cells throughout their length. The otocyst canals open on the surface of the body. But we cannot do more than select a few points from this careful study.

Hinge of Ætheria.*—L. Waagen has made a detailed study of the remarkable, much reduced, and partly obliterated hinge (of the Najad type) in *Ætheria*, correlating its peculiarities with the attachment and inward shunting of the ligament-complex, and discussing its taxonomic interest. He has also notes on a type of a new sub-genus—*Clessinella sturanyi*.

Arthropoda.

a. Insecta.

Evolution of Social Bees.†—R. Dittrich notes that the gulf between solitary and social bees is not so real as used to be supposed. Transitional states are now known. It has been pointed out by von Buttel-Reepen that the social mode of life is marked by three distinctive features:—(1) the differentiation into fertile females and workers; (2) the utilisation of wax for some kind of comb; and (3) the accumulation of stores, especially of pollen and nectar. As regards modes of life, the following series may be suggested.

I. Bees living alone:

- A. The mother dies after oviposition and providing food for the larvæ, but without ever seeing the brood.
  1. The nests are formed quite apart: *Prosopis*, *Ceratina*, *Osmia papaveris*, etc.
  2. The females work independently, but the nests are formed in colonies, and there may be mutual aid against attack: *Anthrena*, *Anthophora*, *Chalicodoma*, *Osmia*, etc.
  3. Females, or females and males, hibernate in companies: *Halictus morio*, *Xylocopa*.
  4. Two or more females use a common hole of refuge: *Panurgus*, *Halictus*, etc.
- B. The mother survives to see the brood and watches over the nest.
  5. *Halictus sexcinctus*.
  6. The cells form a comb: *Halictus quadricinctus*.
  7. The first-born young are all females, they work in the old nest, and parthenogenetically produce males and females: *Halictus scabiosus*.
  8. The next stage (according to Buttel-Reepen) should be that in which the mother and the parthenogenetically reproductive young work together in the old nest; but a representative of this stage has not yet been found.

* SB. k. Akad. Wiss. Wien, cxiv. (1905) pp. 153–82 (1 pl. and 2 figs.).
† Jahresb. Schlesischen Ges. vaterländ. Cultur., lxxxiii. (1906) 2te Abt. (Zool. Bot. Sektion) pp. 1–2.

II. Bees living socially :

9. The fertilised female hibernates alone; forms, in spring, a new nest; is helped by a brood of workers which are only parthenogenetically reproductive in isolated cases; and produces in the course of the summer males and females. In autumn the whole society dies off except the fertilised females: humble-bees.
10. Permanent societies, with imperfect combs: the tropical species of *Melipona* and *Trigona*.
11. Permanent societies, with perfect combs: *Apis mellifica*, *A. dorsata*, *A. florea*.

Among the humble-bees, some (in the north) are quite solitary (females and males, without workers); some (e.g. in Germany) form summer-societies; some (e.g. in Corsica and the Balearic Islands) partially survive the winter as societies; and, finally, some tropical forms (according to R. v. Jhering) are permanently social, with many females. The particular kind of honeycomb characteristic of *Apis* remains quite apart from the other forms.

Genus Simulium.*—E. Roubaud finds that the genus *Simulium* Latreille may be conveniently divided into two new sub-genera—*Pro-Simulium* and *Eu-Simulium*—which differ as regards the second joint of the posterior tarsi, the pupal cases, and the nymphal filaments.

Undescribed Organ in Thorax of Winged Ants.†—Charles Janet describes a mesonotal and a metanotal diaphragm in males and females of *Lasius niger*, which bring about a certain displacement of the blood during the resting periods of the wing-muscles, or after their disappearance.

Stalked Eggs of Cynips tozæ and Synergus reinhardi.‡—E. Bugnion describes the stalked egg of *Cynips tozæ*, and also that of *Synergus reinhardi*, which is commensal with *Cynips kollari*. In *Synergus* the stalk has a length of 1·004 mm., more than five times the length of the egg (0·197 mm.). Males were observed, but the fertilisation is difficult to explain, for the egg-envelope is thick, and there is no micropyle.

Pachylomma cremieri and Lasius fuliginosus.§—Ruggero Cobelli finds that when the ants (*Lasius*) transport their larvæ from the summer nest on the willow-tree to the subterranean winter nest at the foot of the tree, the rare parasite *Pachylomma cremieri* de Romand inserts its eggs on the ant-larvæ. The parasitic eggs are thus taken with the larvæ to the hibernation quarters, and it is probable that the metamorphosis of the *Pachylomma* is completed when the ant-larvæ are again removed in spring to the willow-tree.

Insects in Amber.‖—F. Meunier gives an account of the Tipulidæ and Dixidæ found in Baltic amber. No fewer than eighteen genera are

* Comptes Rendus, cxliii. (1906) pp. 519–21.
† Tom. cit., pp. 522–3 (1 fig.).
‡ Bull. Soc. Vaudoise Sci. Nat., xlii. (1906) pp. 185–96 (8 figs.).
§ Verh. k.k. Zool. Bot. Ges. Wien, lvi. (1906) pp. 475–7.
‖ Ann. Sci. Nat. (Zool.) iv. (1906) pp. 349–401 (5 pls.).

represented, and a useful diagnostic table is given. The majority of the forms are new, and thirty-seven new species are established.

Alimentary Canal of Mosquito.*—Millett T. Thompson gives a detailed account of the alimentary canal and associated parts in the larva, pupa, and imago of *Culex*, together with comparative notes on *Anopheles* and other genera.

Reactions of Caterpillars and Moths.† — Alfred G. Mayer and Caroline G. Soule have made numerous interesting experiments, e.g. on the larvæ of the milk-weed butterfly (*Danais plexippus*). The caterpillar is positively heliotropic to the ultra-violet rays, but almost, if not quite, unresponsive to the rays visible to us. It is negatively geotropic. These two reactions serve to maintain it near the upper part of the food-plant. If it came down it might starve before it found another milk-weed.

The caterpillar has no inherent perception of the form or colour of its food, but is guided by a chemical sense. Once the eating reaction has begun, the caterpillar may be induced to eat substances which it would never have commenced with. This tendency to continue activity "in the face of a non-stimulus," is called the momentum of its reaction.

If a "distasteful" leaf is presented at intervals of 1½ minutes, the caterpillar takes about the same number of bites each time; but if it be presented at intervals of about 30 seconds, the larva takes fewer and fewer bites, and then ceases. No associative memory of more than 1½ minutes' duration can be demonstrated in caterpillars.

A constantly repeated stimulus loses its effect, and this may be due not to fatigue, but to internal changes which express themselves in modified behaviour.

The caterpillars of *Samia cynthia* and *Callosamia promethea* are negatively geotropic when about to pupate, and always pupate head upward, even if the cocoon be inverted when the outer case has been spun. The mating instinct of *Porthetria dispar* is, on the part of the male, a reaction of chemotaxis. The normal females show a decided selection against wingless males, though not against abnormally coloured ones. The blinded female does not select against wingless males.

Galls due to Larvæ of Copium.‡—C. Houard describes the peculiar effects produced in the flowers of *Teucrium chamædrys* and *T. montanum* by parasitic larvæ of *Copium* (a genus of Tingidæ, Hemiptera-Heteroptera). Thus, to illustrate, the walls of the corolla are thickened, affording nutritive tissue for the larvæ; on the other hand, there is castration of the reproductive organs of the flower.

Kakao Capsid.§—O. M. Reuter points out that the "bark-bug" of the West African kakao, recently described by Th. Kuhlgatz as *Dermatostages contumax* g. et sp. n., is identical with a genus of Bryocorariæ described by Haglund under the name *Sahlbergella*, and is closely related to *Odoniella* Hagl., *Rhopalisechaus* Reut., and *Volkelius* Dist.

* Proc. Boston Soc. Nat. Hist., xxxii. (1905) pp. 145–202 (6 pls.).
† Journ. Exper. Zool., iii. (1906) pp. 415–33.
‡ Comptes Rendus, cxliii. (1906) pp. 927–9.
§ Zool. Anzeig., xxxi. (1907) pp. 102–5.

Life-history of Australian Dragon-fly.* — R. J. Tillyard has studied the life-history of *Lestes leda* Selys, a small blue Agrionid, the commonest dragon-fly of the Sydney district. The eggs are laid in water, and the process of oviposition is specially interesting, in that the male assists. He clasps the female round the neck by means of his anterior appendages, which are forcipate. He then seizes a small reed or leaf just standing out of the water, and, holding on tightly, arches his abdomen, dragging the female up behind him. The female then reaches out with her abdomen, feeling for the surface of the water. If they are not low enough down, they creep gradually until just within reach, when the ova are laid. A remarkable fact is that other dragon-flies, e.g. *Hemicordulia tau*, on discovering them, hover around, and try to knock them into the water. Even males of their own species will interfere, and endeavour themselves to get possession of the female. There are two broods in the year. All the stages are described.

γ. Myriopoda.

Phagocytosis in Diplopoda.†—L. Bruntz has made experiments on three Millipedes—*Glomeris marginata*, *Julus sabulosus*, and *Polydesmus complanatus*—in reference to phagocytosis. He finds that the phagocytic function is effected by the blood-corpuscles and by phagocytic organs. There is no corpuscle-forming organ in Millipedes, and it is therefore probable that the blood-corpuscles in adults are formed afresh by the indirect division of those in circulation. Those still developing have a phagocytic function ; those fully formed are both glandular and phagocytic. The phagocytic organs are masses of fixed phagocytic cells, in relation with the perineural sinus in *Glomeris* and *Julus*, beside the latero-dorsal adipose masses and between adjacent rings in *Polydesmus*.

δ. Arachnida.

Chernes cyrneus in Nottinghamshire.‡ — H. Wallis Kew calls attention to this recent addition to the list of British False-scorpions. It is one of the largest of the European species of the genus. It lives, perhaps exclusively, under the bark of old partly dead or dead standing trees, and appears to be a member of the old forest fauna of Europe and Northern Africa. The author found twelve individuals at Edwinstone. A full description is given.

Indian False-scorpions.§—C. J. With gives a notable account of the Indian Chelonethi, especially of those collected by the Danish 'Galathea' and Siam Expedition. After discussing the geographical distribution of the order, he gives a careful anatomical description of the "antennæ," maxillæ, palps, legs, the coxal sac, etc. He then passes to the classification and the systematic part of the memoir. In the genus *Chelifer* alone he deals with thirty-five species.

* Proc. Linn. Soc. N.S. Wales, xxxi. (1906) pp. 409–23 (2 pls.).
† Arch. Zool. Expér., v. (1906) pp. 491–504 (1 pl.).
‡ Ann. Rep. Nottingham Naturalists' Society, liv. (1907) pp. 41–6 (1 pl.).
§ Mem. Acad. R. Danemark, 7me série (Section des Sciences) iii. No. 1 (1906) pp. 1-214 (4 pls. and map.).

New Australian Tick.* — W. W. Froggatt has discovered an indigenous species in New South Wales of the family Argasidæ, *Argas lagenoplastis* sp. n. It is common in the clay nests of the Fairy Martin or "Bottle Nest Swallow" *Petrochelidon* (*Lagenoplastes*) *ariel*, under the lining of feathers and grass. It is usually found in the nests containing young birds, remaining for some time after the nestlings have flown. It probably has as wide a range as the host, which is considerable.

Anatomy of Boophilus annulatus Say.†—S. R. Williams has investigated the structure of the Texas fever cattle-tick, and describes its external form, male and female; its musculature, mouth-parts, and alimentary canal; salivary and skin-glands, and so on. As the internal anatomy of Ticks is little known, the following summary of the author's results may be given. There are external porose areas, which are sensory, with sensory cells in the openings. There are numerous multicellular glands, with openings in the cuticula. The alimentary canal is a slightly curved tube passing through the brain, and with six large diverticula, which occupy most of the body-cavity in immature females and males. There are triangular deeply-staining cells in the walls of these diverticula, which, it is suggested, function as a "liver." The salivary glands are paired racemose glands opening into the mouth-cavity. The excretory system has a series of diverticula following those of the digestive system; all are connected with a renal sac. Adult females probably take in little food, and eject nothing from the alimentary canal or the renal system. The female organs differ in every detail from those of *Ixodes ricinus*. The ovary in *Boophilus* is a continuous loop from one oviduct to the other, passing backwards around the main alimentary canal. There is a receptaculum seminis, which receives the oviducts and connects with a dorsal uterus. There are paired shell-glands emptying into the uterus. Ripe sperms were found in the receptaculum. The male organs are paired testes, vasa deferentia, and a mass of seminal vesicles in a median position.

Life-history of Fresh-water Mites.‡— C. D. Soar communicates some interesting notes. A mass of pink jelly on the stem of *Anacharis* proved to be the ova of a species of *Eulais*; *Limnesia histrionica* lays its eggs on the under-side of the leaves of the same plant. Larvæ occur in very varied habitats, e.g. larvæ of *Arrhenurus* on dragon-flies, of *Hydrachna* on *Corixa*, *Dytiscus*, etc., of *Hydryphantes* on a fly, *Cœnia obscura*, which breeds in aquatic plants, of *Atax crassipes* in *Spongilla*. Apart from forms which live inside mussels, the nymphs are never parasitic. In some cases, e.g. *Hydrachna*, the nymph stage lasts for twelve months. There seems to be considerable variety in the mode of transition from the nymph stage to the adult stage.

Gibocellum sudeticum.§—W. Sorensen, in a lively paper entitled "Un animal fabuleux des temps modernes," maintains that the remarkable

* Proc. Linn. Soc. New South Wales, xxxi. (1906) p. 408.
† Proc. Boston Soc. Nat. Hist., xxxii. No. 8 (1905) pp. 313–34 (5 pls., 3 figs.).
‡ Journ. Quekett Micr. Club, 1906, pp. 359–70 (5 pls. and 2 figs.).
§ Oversigt k. Danke Videnk. Selskabs Forh., 1906, pp. 197–232 (8 figs.).

type *Gibocellum*, found and described by A. Stecker in 1875, and placed in a special family near Cyphophthalmidæ, was altogether a product of Stecker's fancy.

ε. Crustacea.

Liriopsidæ.*—Maurice Caullery gives an interesting account of two of these parasites on parasites—namely, *Danalia curvata* Fraisse, a parasite of *Sacculina neglecta*, which is a parasite of *Inachus scorpio*, and *Liriopsis monophthalma* Fraisse, a parasite of *Peltogaster curvatus*, which is a parasite of *Eupagurus meticulosus*.

Like other Epicarids, *Liriopsis* penetrates into its host as a cryptoniscid larva, and is then male. It occurs free in the pallial cavity of *Peltogaster*; it undergoes metamorphosis without fixation; it undergoes a moult, after which it shows only one pair of appendages (the second pereiopods); it becomes vermiform (with a prolonged persistence of the cephalic segment), then globular, then like a figure 8, half of which protrudes; later on the ovary matures.

The cryptoniscid larva of *Danalia* fixes on the *Sacculina*, or oftener on some point on the ventral surface of the abdomen of the crab (*Inachus*). After a moult, it grips its host with its only remaining appendages—as before, the second pair of pereiopods. The pre-buccal region forms a perforating tube, the mouth becomes actively suctorial, the second pereiopods fall off. The body becomes a sac, bent like the letter U.

The two types differ considerably as to their larval form and subsequent history. Both show protandrous hermaphroditism.

Species of Lernanthropus.†—Empedocle Goggio gives a list and bibliography of 31 described species of this genus of parasitic Copepods, and describes *L. foliaceus* Richiardi, *L. vorax* Rich., and *L. lichiæ* sp. n. He also discusses and figures *L. gisleri* van Ben., *L. brevis* Rich., *L. micropterygis* Rich., and *L. tylosuri* Rich.

Sex-Determination in Daphnids.‡—A. Jssakówitsch finds that in *Simocephalus vetulus* and *Daphnia magna* the appearance or disappearance of the sexual forms depends on the nutritive conditions and on the surrounding temperature (affecting the nutrition). When the mother-animal cannot afford sufficient food to the eggs, they develop into males; if the lack of nutrition goes further, a large number of primary egg-cells combine to furnish a single winter-ovum. There is no cyclic reproduction in Weismann's sense among Daphnids. For experimental purposes it is useful to have a main culture at 22° C., and an accessory culture at 8°–16° C. From the latter strong fecund females can be continually supplied, to replace those in the main culture which soon become exhausted by persistent parthenogenesis.

Monograph on Ligia.§—C. G. Hewitt gives an account of the biology, morphology, and development of *Ligia oceanica*. This Isopod

* Comptes Rendus, cxliv. (1907) pp. 100–2.
† Atti. Soc. Tosc. Sci. Nat. Pisa, xxii. (1906) pp. 134–49 (1 pl.).
‡ Arch. Mikr. Anat., lxix. (1906) pp. 223–44 (12 tables).
§ L.M.B.C. Memoirs, xiv. (1907) pp. 1–37 (4 pls.).

belongs to the tribe Oniscoidea, which are characterised by being terrestrial. This tribe includes all the so-called "wood-lice." Their abdominal appendages are fitted for air breathing, but in *Ligia* there is a very near approach to branchial respiration, as moisture is necessary. The body is oval in shape, and the seven pairs of thoracic appendages are similar in character. *Ligia* has a wide distribution, and occurs just above high-water mark, generally in deep narrow crevices in the rocks. They are unable to withstand prolonged immersion in sea-water, and less able in fresh-water. They feed on decaying organic matter, and are nocturnal in habit.

Ostracoda of Massachusetts.*—J. A. Cushman records these from south-eastern Massachusetts. Seven species are reported, bringing the number now known from fresh-water in New England up to nine. The distribution of species was found to be singularly local. Of three species of *Cypris* found, all occurred in pools in the vicinity of Boston, and but a short distance apart, yet no one collection contained more than a single species.

American Marine Ostracoda.†—J. A. Cushman gives a systematic account of collections made in the vicinity of Wood's Hole. Sixteen of the species obtained are identical with those of European waters, including the Mediterranean. Of these, all but one, *Cytheridea rubra*, are fairly northern species, extending around the whole northern Atlantic. Certain forms described as new are allied to European species. Others seem to be entirely different, and may represent species which are more southern in their range, and which are probably confined to the western side of the Atlantic. There is some indication of a periodicity of species in protected waters.

Mysidæ of West of Ireland.‡—W. M. Tattersall describes six new species belonging to the sub-family Leptomysinæ of the Mysidæ. They were captured off the south-west coast of Ireland, in depths ranging from 465 to 800 fathoms. Two are types of new and interesting genera, while the other four belong to two recently defined deep-water genera characterised by the imperfectly developed eyes which are possibly modified for tactile functions. Two species new to the British and Irish list, *Hansenomysis Fyllæ* Hansen and *Erythrops microphthalma* G. O. Sars, were taken in 400–800 fathoms, off the coast of Kerry.

Sexual Modification of Hermit Crab by Peltogaster.§—F. A. Potts finds that the infection of the hermit crab *Eupagurus meticulosus* by the Cirripede *Peltogaster curvatus* has the effect of diminishing immediately the size of the gonads and suppressing their functions. This is probably effected through interference with the general nutrition. At the early stage of the external parasitism ova make their appearance in the glandular part of the testis. Their fate has not been traced, but it seems probable that they persist and grow. No corresponding changes

* Amer. Naturalist, xli. (1907) pp. 35–9.
† Proc. Boston Soc. Nat. Hist., xxxii. (1906) pp. 359–85 (12 pls.).
‡ Ann. Mag. Nat. Hist., cix. (1907) pp. 106–18.
§ Quart. Journ. Micr. Sci., l. (1906) pp. 599–621 (2 pls.).

could be traced in the ovary. The male secondary sexual characters are stimulated to development towards the female type under influence of the parasitism. There is a complete series between unmodified crabs and crabs which have almost entirely assumed the female characters. In *Eupagurus prideauxi* a similar development of the female secondary sexual characters in the male was observed. It would appear that the secondary sexual characters are not directly consequent upon the primary, but that both are attributable to some change in the general metabolism.

Globuligenic Organ in Decapods.*—L. Bruntz gives some notes on the histology of this organ in the crayfish. It is an extremely thin gland, separated from the stomach by a fine layer of connective tissue. It resembles a similar organ in Stomatopoda in consisting of a large number of cellular nodules, without a proper envelope, and lying in the meshes of a connective-fibrillar network. They communicate with the blood-vessels through the ophthalmic artery in the crayfish, and the ventral artery in Stomatopods. The young blood globules do not pass directly into the arterial system, but fall into the hæmocœl, and are transported by the venous blood passing through the tissues.

Annulata.

Fertilisation in Serpula crater.†—A. Soulier finds this Polychæt a very convenient subject for the study of fertilisation phenomena. Numerous vacuoles are formed in the erythrophil substance of the nucleolus; they raise the nucleolar membrane like buds; they separate from the nucleolus, taking with them cyanophil granulations, which become free in the nucleus, and eventually form vitelline granulations in the cytoplasm.

The centrosome of the ovum is double; the two daughter-centrosomes are united by a central spindle which soon disappears. The centrosomes penetrate into the nucleus, a second central spindle is formed between them, while mantle-fibres are formed by the rays of the two asters. This first maturation-spindle soon attains complete development, and the first polar body is expelled. The centrosome remaining in the oocyte doubles, and gives rise to the centrosomes of the second maturation-spindle. After the expulsion of the second polar body, the remaining centrosome soon disappears. The nucleolus also vanishes. The presence of a spermatozoon in the cytoplasm hastens the processes of maturation.

The spermatozoon after entering the ovum is at first intensely stainable, but this character is soon lost. The chromatin divides into small grains which soon become vesicular. The head moves through 180°, and soon two centrosomes are seen, derived from the spermocentre and each surrounded by an aster. The female pronucleus becomes vesicular, and is gradually reconstituted. The male pronucleus is at the same time reconstituted. The two pronuclei are juxtaposed and fuse. The centrosomes of the first segmentation spindle are derived from the spermocentre.

* Arch. Zool. Expér., Notes et Revue, xxxv. (1906) No. 3, pp. lix.–lxiv.

† Arch. Zool. Expér., v. (1906) No. 3, pp. 403–89 (1 pl. and 31 figs.).

Vermilia and Pomatoceros.*—K. J. Bush points out that no little confusion has arisen in regard to the relation of two genera of tubicolous Annelids, viz. *Vermilia* Lamarck, 1818, and *Pomatoceros* Philippi, 1844. The genus *Vermilia* has become a kind of dumping ground for ill-defined, little understood, often unfigured forms, even sometimes for empty tubes. Bush proposes to clear the matter up by defining the following genera: *Vermiliopsis* Saint Joseph, type *Vermilia infundibulum* Philippi; *Metavermilia* Bush, type *Vermilia multicristata* Philippi; *Paravermilia* Bush, type *P. bermudensis*; *Pseudovermilia* g. n., type *Spirobranchus occidentalis* M'Intosh.

Paravermilia and Pseudovermilia.†—K. J. Bush gives an account of these two genera of tubicolous Annelids, which he has established to receive some new species from the Bermudas, and some forms previously described under the genera *Spirobranchus* and *Vermilia*.

Nephridia of Dinophilus.‡—Cresswell Shearer has examined these. They are of the primitive solenocyte-bearing type common in Annelids. The solenocytes are typical, their canals are definitely closed, and do not open into the primary body-cavity. The nephridia are not ciliated, but the flagella of the solenocytes beating down the length of the canals give them the appearance of being so. The presence of solenocytes in *Dinophilus* is of some morphological significance on account of the relationship this worm shows with the Turbellaria. On the other hand, in the absence of our knowledge of their existence in lower forms, it may be held to indicate close affinity of *Dinophilus* with the more highly developed Annelids, and especially the Polychæts.

Swiss Oligochæta.§—E. Piguet gives a faunistic account of Æolosomatidæ, Naididæ, Tubificidæ, Lumbriculidæ, and Haplotaxidæ found by him in Switzerland, and describes an interesting new species, *Rhyacodrilus lemani*, from a depth of 120 metres in the Lake of Geneva.

Pelagosphæra and Sipunculus Larvæ.‖—J. W. Spengel refers to a paper by the late Pio Mingazzini on *Pelagosphæra aloysii* g. et sp. n., a reputed pelagic Gephyrean. But Mingazzini's figures show that this supposed new form is the larva of a *Sipunculus*, closely resembling a large Mediterranean larva (probably of *S. tesselatus*), and with great probability referable to *S. discrepans*. What Mingazzini took for an ovary is a typical organ (of unknown function) in *Sipunculus* larvæ.

Tumour in a Sipunculid.¶—Marcel A. Hérubel directs attention to the occurrence of a tumour in a female of *Sipunculus nudus*. It was a muscular tumour, probably of parasitic origin, and containing many phagocytes. The muscle-fibres enveloped by the phagocytes were in process of being directly attacked by them; those not in contact with phagocytes were being disrupted and dissolved; those still more distant

* Amer. Journ. Sci., xxiii. (1907) pp. 52–8. † Tom. cit., pp. 131–6.
‡ Quart. Journ. Micr. Sci., l. (1906) pp. 517–45 (2 pls.).
§ Rev. Suisse Zool., xiv. (1906) pp. 389–403 (1 fig.).
‖ Zool. Anzeig., xxxi. (1907) pp. 97–9.
¶ Comptes Rendus, cxliii. (1906) pp. 979–81.

were undergoing chemical dissolution like self-digestion. Thus three modes of muscular degeneration were illustrated in the tumour.

Morphology of Hirudineæ.*—N. Livanow gives an account of the anatomy of *Acanthobdella paludina* Grube, and from a consideration of the general characters of the group, he concludes that for differential diagnosis the following are of importance, viz. :—the secondary ringing of the somite ; the development of suckers at the expense of a few body somites ; the typical structure of the muscle-cells ; the development of the mesenchyme and related reduction of cœlom ; the development of a peripheral and subcutaneous cœlom ; the differentiation of ganglion-cell clusters in the central nervous system ; the differentiation of endodermal gut into a middle and posterior section ; the closed condition of the nephridia cœlom-wards, the absence of ciliation in the excretory section, and also the anatomical independence of the funnel apparatus from the excretory section ; the development of ovarian sacs in the female sexual apparatus.

Vascular System of Piscicola.†—W. Selensky has been able, by reconstructing his sections, to present a clear account of the intricacies of the two quite different and separate sets of vessels in this leech, viz. the blood-vascular system proper, and the lacuna-like canals and spaces which represent remains of the secondary body-cavity.

Platyhelminthes.

Parasites and Diseases of Fishes.‡—James Johnstone gives an account of Cestodes and Trematodes obtained mainly from skates and rays. No new species are described, although the occurrence of varieties is noted, e.g. in *Echeneibothrium variabile* van Beneden, of which three well-defined forms were obtained. An account is given of a fungoid disease attacking *Pleuronectes platessa*. It was fatal in a number of cases. The fungus, which appears to belong to the Entomophthorineæ, occurred in the liver, kidney, and mesenteries ; it is supposed to have gained access to the tank through the liberation of spores from the bodies of insects dying on the surface of the water. An account is given of subcutaneous tumours in the dab, *Pleuronectes limanda*, the cause of which is undetermined.

Entozoa of British Marine Fishes.§—W. Nicoll gives descriptions of a number of Trematodes from various common shore and food fishes. In a large number of cases known parasites are recorded from new hosts. It appears likely in some cases, e.g. *Podocotyle atomon* Rud. that the entozoa of a particular fish are determined more by its environment than by its specific nature. Further, in the case of littoral fishes, dependent on local faunæ for their food, the parasites appear to vary with the locality.

Mollusc-infecting Trematodes.‖—M. V. Lebour describes larval stages of three Trematodes, obtained respectively from the common

* Zool. Jahrb., xxii. (1906) pp. 637–866 (9 pls.).
† Zool. Anzeig., xxxi. (1906) pp. 33–44 (4 figs.).
‡ Proc. and Trans. Liverpool Biol. Soc., xx. (1906) pp. 295–329 (1 pl. and 13 figs.).
§ Ann. Mag. Nat. Hist., cix. (1907) pp. 66–94 (4 pls.).
‖ Tom. cit., pp. 102–6 (2 pls.).

molluscs *Cardium edule*, *Purpura lapillus*, and *Patella vulgata*. An interesting fact regarding the *Cardium* parasite is that the cercariæ encyst within the sporocyst. They possess a tail, although under these circumstances this organ must be quite useless. The cercaria of *Purpura* is very contractile, and when moving uses its body more than its tail, shortening and elongating itself continually.

Structure and Development of Rediæ.*—E. Rossbach has studied the rediæ in *Paludina* (*Cercaria echinata*, adult in ducks, etc.) and *Lymnæus* (*Cercaria armata*, adult in frogs), and gives a full account of their structure. He also describes their development, with particular reference to the pharynx, body-cavity, excretory vessels, and terminal cells.

Incertæ Sedis.

Budding, Degeneration, and Regeneration in some Marine Ectoprocta.†—O. Römer has studied *Alcyonidium mytili* and *Bugula avicularia*. In the formation of the polypid-bud the ectoderm and mesoderm of the zoœcium take part. The mesodermic elements of the daughter-zoœcium arise from the mesenchyme cells of the mother-zoœcium, as well as from proliferating cells of the ectoderm of the daughter-zoœcium. The processes of degeneration and phagocytosis are closely similar to those which occur in the degeneration of Ascidian and in the metamorphosis of Muscid larvæ. The regenerating polypid is formed like the first polypid-bud, by an invagination of the ectoderm with co-operation of the mesoderm, as Seeliger observed in Entoprocta. It is remarkable that old, extremely delicate ectodermic epithelia, poor in protoplasm, should have the capacity of re-exhibiting complete embryonic capacity. They become rich in protoplasm, acquire cylindrical form, return to the blastula condition, show gastrular invagination, and form a new polypid with the most varied tissues.

Affinities of Hislopia.‡—Nelson Annandale discusses Carter's genus *Hislopia*, and comes to the conclusion that it is a somewhat aberrant representative of the Ctenostomata, the orifice of the zoœcium having undergone special modification, possibly in connection with life in fresh-water. Probably the genus should be regarded as constituting a distinct family closely allied to the Paludicellidæ.

New Species of Myzostoma.§—August Reichensperger describes *M. vincentinum* sp. n., from *Pentacrinus decorus*. Its position seems to be near M. *coronatum* Graff.

Rotifera.

Sex-determination in Hydatina.‖—R. C. Punnett, as a result of breeding many generations of this Rotifer, comes to the conclusion that Maupas' theory that sex in *Hydatina* is determined by temperature, as well as Nussbaum's idea that it is determined by good or bad nutrition,

* Zeitschr. wiss. Zool., lxxxiv. (1906) pp. 361–445 (3 pls.).
† Tom. cit., pp. 446–78 (2 pls.).
‡ Bull. Mus. Comp. Zool. Harvard, xliii. (1906) pp. 199–201 (5 figs.).
§ Journ. Asiatic Soc. Bengal, ii. (1906) pp. 59–63 (2 figs.).
‖ Proc. Roy. Soc., Series B, lxxviii. (1906) pp. 223–31.

must alike be rejected as incorrect. Starting with single females, the author has bred as many as sixty-four and seventy-three generations, testing with great care the sex-character of each offspring. Green *Euglenas* were used as food during these experiments, which lasted about eighteen months. *Hydatina*, as is well known, produces either parthenogetic female eggs, parthenogenetic male eggs, or fertilised resting eggs, but any given female lays but one of these classes of eggs during her lifetime.

The author's experiments have led him to the conclusion that there are three different types, or strains, in the Mendelian sense, of parthenogenetic females, namely: A, females producing a high percentage of females which will lay male eggs; B, females producing a low percentage of females laying male eggs; C, females producing females which never lay male eggs. A pure strain of type C was cultivated for seventy-three generations, during which 304 individuals were tested and none produced males. Individuals of this strain were subjected to temperature tests, as well as to starvation tests, but no males were produced.

A consideration of the whole of these results has led the author to make some remarks on the nature of parthenogenesis in *Hydatina*, and to conclude that "it seems not inconceivable that the female-producing females are really hermaphrodite, though the male gametes may not exhibit the orthodox form of spermatozoa."

Tetramastix opoliensis.*—C. F. Rousselet supplies a rectified figure and description of this rare Rotifer, showing that it belongs to the family of the Triarthradæ, instead of that of the Anuræadæ, as was at first supposed. The error has been due to the fact that the creature was first found in a fully contracted state only, when the two long skipping spines are directed forward, apparently continuous with the integument. A drawing of the living animal by St. Hlava has enabled the author to correct the error. So far, this species has been found three times only, namely, by Zacharias in 1897, in material from the Oder, by Oppeln, Germany; by St. Hlava in 1899, in a pond near Tabor, Bohemia; and in 1905 by the author, in a pool in the Matopos, in Rhodesia.

Morphology and Variations in the Wheel-organ of Rotifera.†—P. de Beauchamp attempts to show that the usual division of the ciliary wreath of Rotifers in trochus and cingulum, almost universally accepted since Cubitt introduced these terms, does not at all apply to the vast majority of species, and, moreover, that this conception is incorrect, as it takes too little account of the band of fine cilia (the ciliated grove) which exists between the trochus and cingulum. The author considers this band to be of prime importance in the morphology of the ciliary wreath, and regards the larger cilia of the trochus and cingulum as only the modified outer margins of this band in a few families, which, unfortunately, have always been taken as the types of the whole class. After giving some exact figures and descriptions of the ciliary wreath of eight species of Ploima, the author proceeds to construct a diagram

* Journ. Quekett Micr. Club, ser. 2, ix. No. 59 (1906) pp. 431–2 (1 pl.).
† Arch. Zool. Expér., ser. 4, vi. (1907) pp. 1–29.

of a simple general type of the Rotatorian ciliary wreath (most nearly represented by that of *Pedalion*), from which all other existing forms can be readily derived by modifications closely related to the mode of life of the species. This general or primitive type consists of a circum-apical band of fine cilia, which becomes enlarged ventrally and around the mouth into a wide ciliated area called "plaque buccale"; this latter may again be subdivided into supra-oral, ad-oral, and infra-oral regions. The circum-apical band incloses a naked portion of the frontal integument, called "plaque syncipitale," which carries sense-organs, and the two openings of the retro-cerebral organ, when present, but never any vibratile cilia. This new conception of the morphology of the wheel-organ of Rotifera deserves careful examination, as it appears to possess good points, and leads to a better understanding of this organ in the whole class.

Cœlentera.

Medusæ of Hawaiian Islands.*—A. G. Mayer reports on a collection made by the 'Albatross' off the Hawaiian Islands, but mostly consisting of forms of wide distribution. Only one Scyphomedusa, *Charybdea moseri* sp. n., appears to be peculiar to the Hawaiian region, and the same is true of the Hydromedusan *Solmaris insculpta* sp. n.

Fresh-water Medusæ.†—Edward Potts gives a review of the known facts regarding the three species of fresh-water jellyfish hitherto discovered, giving a particular account of *Microhydra ryderi* Potts. Edward T. Browne describes the medusa of *Microhydra ryderi*, and compares it with *Limnocodium*. The young medusa has the appearance of an Anthomedusa; it is undoubtedly distinct from *Limnocodium*.

Pelagic Hydroid Colonies.‡—O. Steche discusses a hydroid colony, which Chun named *Perigonimus sulfureus*, found attached to the shell of *Hyalæa*. All the nutritive individuals are concentrated beside the opening of the shell; the other areas show only medusoid buds. There is no hydrocaulis; polyps and medusæ arise singly and directly from the anastomosing hydrorhiza. The medusoids exactly resemble those of *Perigonimus*, but the polyps are very peculiar. They are relatively very large, and have a plump, barrel-like form, with 6–9 short, thick tentacles. One of them showed an annular constriction in the middle, suggestive of the transverse division in *Protohydra*. Besides nutritive polyps and medusoids there were some short, conical, abortive, probably protective, individuals. The cœlenteron of the nutritive polyps contained molluscan eggs, probably those of *Hyalæa*.

New Species of Sarcophyllum from New Zealand.§—W. B. Benham gives a preliminary description of *Sarcophyllum bollousi* sp. n., the only Pennatulid, apart from *Virgularia gracillima*, that has hitherto been met with in the coastal waters of New Zealand. It differs from the Australian species, *S. grande*, in such a large number of characters that

* Bull. U.S. Fish Commission for 1900, part iii. (1906) pp. 1131–43 (3 pls.).
† Quart. Journ. Micr. Sci., l. (1906) pp. 623–45 (3 pls.).
‡ Zool. Anzeig., xxxi. (1906) pp. 30–2 (2 figs.).
§ Tom. cit., pp. 66–7.

it deserves a distinctive name. The rachis (70 mm.) is only slightly longer than the stalk (75 mm.); the broadest region, near the rounded apex, is almost equal to its length. There are thirty pairs of rather thick and fleshy pinnules, each with a single undulating metarachidian row of autozooids (cf. four to five rows on each face of the pinnule in the Australian species). The siphonozooids form a conspicuous cushion-like thickening on the proximal region of the prorachidian edge of the pinnule; this cushion just passes over on to the upper surface, but on the lower surface of the pinnule it forms a very marked "basal" plate which reaches the metarachidian margin.

Cœlentera from the Spanish Coast.*—José Rioja y Martin communicates, an annotated list of the Cœlentera in the collection of the Biological Station at Santander. Thus, to select the Alcyonacea, he records *Alcyonium palmatum*, *A. digitatum* (?), *A. glomeratum*, *Pteröeides griseum*, *Pt. spinulosus*, *Pennatula phosphorea*, *P. rubra*, *Kophobelemnon* sp., *Funiculina quadrangularis*, *Veretillum cynomorium*, *Gorgonia verrucosa*, *G. cavolinii*, *Muricea chamæleon*, *M. echinata*, *Gorgonella sarmentosa*. His list will be of use in faunistic studies.

Porifera.

Larvæ of Hircinia variabilis.†—E. Hammer describes the barrel-shaped, free-swimming larvæ, with a dermal layer of elongated, narrow, flagellate cells entirely inclosing an internal cell-mass. Peculiar bodies, apparently containing chromatin, were found in the interior of the larvæ, and resembled the heads of the peculiar filaments of the adult sponge.

Protozoa.

Thalassothamnidæ.‡—V. Haecker concludes that Schröder's *Cytocladus* and a new genus *Thalassothamnus* require the establishment of a new family (Thalassothamnidæ) of deep-sea Radiolarians. The family should be included in Brandt's order Collidæ, near Haeckel's Orosphæridæ. In the two genera mentioned only one "double-spicule" is differentiated. In *Thalassothamnus* the nodal points of the double spicule are usually separate; the central capsule is spherical or bulged out by the radial spines. In *Cytocladus* the nodal points of the double spicule are fused; the central capsule is dendriform or branched.

From the 'Valdivia' material Haecker has obtained three species of a remarkable new genus, *Astracantha*, which also requires a new family, Astracanthidæ. They have delicate stellate skeletons with 15–40 radial spines, which are hollow and spinose or bear dichotomous branches, and have their inner ends abutting against one another in the centre. There are always two central capsules, with typical astropyle and a long "proboscis." The family should be placed between Aulacanthidæ and Aulosphæridæ.

* Bol. Soc. Españ. Hist. Nat., vi. (1906) pp. 275–81.

† SB. Ges. Nat. Freunde Berlin (1906) No. 6, 6 pp. (1 pl.). See also Zool. Zentralbl., xiii. (1906) pp 631–2.

‡ Zool. Anzeig., xxx. (1906) pp. 878–95 (16 figs.).

Light Reactions of Stentor cœruleus.*—S. O. Mast finds that Stentors free to swim in all directions orient and swim from the source of light. They orient by means of motor reactions, i.e. by turning toward a structurally defined side, and then proceeding on a new path at an angle with the old one. If a single reaction does not result in orientation it is repeated until the anterior end happens to become directed from the source of light.

The motor reaction is induced by a sudden increase in light intensity regardless of the relation between the direction of the rays and the direction of movement of the animals at the time the intensity is increased. If a source of light to which Stentors are oriented is increased in intensity, the animals respond with the motor reaction and are thus thrown out of orientation, but by repeating the motor reaction they soon become oriented again.

The anterior end is the most sensitive part. The Stentors become readily "acclimated" to light. Once oriented they remain oriented, if the light intensity is not too high, for they are least sensitive to light when the rays strike the posterior end.

Attached Stentors respond to increase in light intensity by contracting or swinging about. They do not orient.

The light reactions of *Stentor*, both free-swimming and fixed, cannot be explained by the tropism theory as defined by Loeb, Verworn, or Holt and Lee.

Structure of Stentor cœruleus.†—O. Schröder has investigated the myonemes and membranellæ. The surface of *Stentor* is well known to show dark granular "rib-stripes," and light, non-granular "intermediate stripes." Under each of the latter a myoneme runs in a clear canal; each is a distinct band, sometimes with alternate dark and light areas, bending inwards at the base, and forming a sort of cone above the foot-place, and running forwards in the other direction as far as the adoral zone. There are no "neurophane" fibrils. The attachment of the membranellæ by basal lamellæ and basal bands running into the cytoplasm is discussed.

New Acinetan Genus.‡—B. Gollin describes from the hairs of the thoracic limbs of *Eupagurus cuanensis* Thomson and *E. excavatus* Herbst., at Cette, a new form, *Dendrosomides paguri* g. et sp. n. The body is trifurcate, 200–300 μ long, ovoid at the base, and having a long, cone-like, chitinous pedicel. There is a thick external pellicle, and longitudinal striations in the sub-pellicle. The branches carry obtuse digitate lobes, which are terminated each by a fascicle of from 8–15 capitate or non-capitate tentacles. The organism is placed provisionally with the Dendrosomidæ.

Vorticellæ on Tadpoles.§—E. Wace Carlier describes a case of tadpoles which bore large numbers of Vorticellæ on their skin, and even

* Journ. Exper. Zool., iii. No. 3 (1906) pp. 359–99.

† Arch. Protistenkunde, viii. (1906) pp. 1–16. See also Zool. Zentralbl., xiii. (1906) pp. 714–15.

‡ Arch. Zool. Expér., Notes et Revue, No. 3, xxxv. (1906) pp. lxiv.–lxvi.

§ Proc. Scott. Micr. Soc., iv. (1906) pp. 133–5.

in the gill-chamber. There was no evidence of parasitism; it is likely that the Vorticellæ fed on the muscle juice diffusing in the water from the flesh given as food to the tadpoles.

New Genus of Dinophysidæ.*—C. A. Kofoid describes from the San Diego region a new genus of Dinophysidæ which he names *Triposolenia*. He gives the following diagnosis: Dinophysidæ with subequal valves, transverse girdle encircling a small head, neck elongated, oblique to anterior process which arises obliquely from a laterally compressed mid-body. Two antapical horns, spreading, curved, approximately balanced, the dorsal a trifle shorter than the ventral. The antapical tips simple, with or without spinules, or projecting tubercles, or major flexures, often with a distal sinistral deflection, thecal wall structureless or pitted. Lists hyaline, ribbed, not excessively developed. Chromatophores yellowish green, if present. In oceanic plankton of warm, temperate, and tropical seas, in the deeper levels, rarely at the surface.

The author discusses the significance of the asymmetry of *Triposolenia* and other Dinoflagellates. It is adaptive to flotation. The various types of asymmetry all have the tendency to orient the passively sinking organism broadside to the direction of descent, and thus to increase the area of resistance.

Structure of Vorticella monilata.†—O. Schröder gives an account of the external sheath and the myonemes of this Ciliate. The external sheath consists of annular bands separated by grooves. The annular bands are composed of cell-like structures with convex projections or knobs. These cell-like structures often contain an internal corpuscle. Besides the myonemes of the adoral spirals and of the vestibule, there are longitudinal myonemes and annular myonemes in the peristomial margin. Many other details are described.

Blastodinidæ.‡—E. Chatton describes *Blastodinium pruvoti* g. et sp. n. observed in pelagic Copepods (Calanidæ) at Banyuls. The parasites occur (from one to thirty in number) in the mid-gut, and by dilating the stomach they compress the gonads, and thus mechanically castrate their hosts. There is periodic segmentation of a mother-cell, giving rise to successive generations of spores. The parasites are referable to the Dinoflagellata, or Peredinians, but their peculiarities of habit and reproduction make it necessary to establish a distinct family.

Parasites of Southern Sudan.§—Sheffield Neave gives an account of parasites noted by him in a journey from Gondokoro to Meshra-el-rek. Trypanosomes were found in the mule, four species of fish (*Bageus bayard*, *Synodontis schal*, *Mugil*, and *Polypterus*), the red-breasted shrike, vulture, and in one case in man. *Filariæ* were found in five species of birds, *Halteridium* in eight, and a new *Hæmamæba*

* Univ. California Publications (Zoology), iii. (1906) Nos. 6–8, pp. 93–133 (3 pls. and 2 figs.).

† Arch. Protistenkunde, vii. (1906) pp. 395–410. See also Zool. Zentralbl., xiii. (1906) pp. 593–4.

‡ Comptes Rendus, cxliii. (1906) pp. 981–3 (5 figs.).

§ Second Report, Wellcome Research Laboratories, Gordon Memorial College, Khartoum, 1906, pp. 183–204 (6 pls.).

somewhat resembling *H. ziemanni* in one. The guinea fowl (*Numida ptilorhyncha*) appears to be very liable to blood-parasites; in one case *Halteridium*, an *Hæmamœba*, and two types of *Filaria*, as well as an undetermined parasite, were found on a single slide.

New Species of Amœbidium.*—E. Chatton describes *Amœbidium recticola* sp. n., a commensal of *Daphnia*. He distinguishes it from *A. parasiticum* in the following diagnoses. *A. parasiticum* is very variable in form and size; it is an external commensal of fresh-water Arthropods, and may incidentally develop in the rectum of Cladocera. It has fusiform spores, slightly arcuate, varying in length from 15–30 μ. *A. recticola* sp. n. is thick and bent at base like a pistol-butt, is a commensal in the rectum of *Daphnia* and other Cladocera; its spores are cylindrical, 8–12 μ.

Culture of Trypanosoma rotatorium.†—G. Bouet gives an account of the morphology of this parasite free in the blood of *Rana esculenta* and in cultures. In the latter, auto-agglutination of young forms occurred, and there appeared a large number of examples with highly refringent granules. Others of a pearly opalescent aspect appeared in the water of condensation. The vitality of the cultures was considerable; in one, trypanosomes lived for five months, but this was exceptional. Various differences between the natural and cultural forms are noted. In particular the latter were much smaller than the natural examples. Attempts at inoculation of *Rana*, *Bufo*, and *Pelobates* were unsuccessful.

Nucleus of Trypanosomes.‡—Ronald Ross and J. E. S. Moore have observed that on colouring liquid blood containing trypanosomes (*T. brucei* and *T. equiperdum*) by various stains, especially the nuclear stains (such as basic fuchsin and thionine), the deeply-stained body does not coincide with that shown by the various modifications of the Romanowsky-Ziemann method as usually applied to dried films, but consists of a much smaller sphere within the latter. It would appear, therefore, that the smaller sphere is the true chromatin portion of the nucleus. This observation tends to re-open the cytological interpretation of trypanosomes.

Yellow Fever in Chimpanzee.§—H. Wolferstan Thomas notes that some *Stegomyia fasciata*, allowed to feed on two cases of yellow fever, were allowed thereafter to feed on a chimpanzee, which developed a benign attack of yellow fever and recovered. Mosquitos were allowed to feed on the chimpanzee during the infective period, and these will be in due course applied to a "non-immune" man to complete the cycle of 'man-chimpanzee-man."

Trypanosoma gambiense in Tsetse Fly.‖—E. A. Minchin reports that in Uganda, experiment and observation have shown that *Trypanosoma gambiense* does not pass through a developmental cycle in the

* Arch. Zool. Expér., Notes et Revue, No. 2, xxxv. (1906) pp. xxxiii.–xxxviii. (4 figs.).
† Ann. Inst. Pasteur, xx. (1906) pp 564–77 (1 pl. and 2 figs.).
‡ Brit. Med. Journ., Jan. 1907, p. 138. § Loc. cit.
‖ Nature, lxxv. No. 1933 (1906) pp. 56–9 (3 figs.).

tsetse fly, but is only transferred mechanically by the fly's proboscis. There is, however, within the fly during the first twenty-four hours a development of two distinct types, the one slender, transparent, and active, the other bulky, granular, and sluggish in movement. Up to forty-eight hours the multiplication continues, and a more "indifferent" type of individual appears. At seventy-two hours, however, the trypanosomes have become greatly diminished, and by ninety-six hours, or slightly later, they have disappeared completely from the gut of the fly, this disappearance coinciding with the complete absorption of the blood with which they were taken in. These facts suggest the commencement of a life-cycle which is not completed, but which might be so under other conditions. It must be borne in mind that the sleeping sickness is a new thing, apparently, on the Victoria Nyanza, as it has broken out there comparatively recently in epidemic form.

Morphology and Life-history of Piroplasma canis.*—G. H. F. Nuttall and G. S. Graham-Smith describe the results of further investigations on this parasite, having given particular attention to the study of the living organism. Nearly all forms of *Piroplasma* possess one densely staining nucleus; many show a second punctiform blepharoplast near it; and a considerable number have a third loose mass of chromatin. These masses may occupy various positions or assume various shapes. Many intracorpuscular forms in stained preparations show both pseudopodia and flagella-like processes, and many of the free forms possess distinct flagella. Round, apparently degenerating forms are common in liver and spleen. Many of the appearances seen in stained preparations are extremely deceptive, and deductions made from them are frequently not confirmed by the study of the living forms; various bodies occur in normal dog's blood which are readily mistaken for piroplasmata. *Piroplasma canis* has a truly intra-corpuscular and an extra-corpuscular stage; the latter is frequently flagellate. Within the peripheral blood a definite cycle of development occurs. Free pyriform bodies invade the corpuscles, becoming round and later amœboid. The amœboid bodies, according to their size, either again form intra-corpuscular pyriform bodies or divide and form two or more pyriform bodies. These leave the corpuscles, and, in doing so, rupture them and enter others. The author's observations lend no support to any of the theories of development which have hitherto been put forward.

Development of Piroplasma canis.†—S. R. Christophers has been successful in tracing the life-cycle of this parasite in India within the tick, *Rhipicephalus sanguineus* Latreille. In the gut of adults or nymphs fed on infected dogs there are globular parasites which, conjugating, yield a club-shaped ookinete. In the case of the adult this migrates to the ova. The larvæ hatched from these are apparently unable to transmit the parasite, but the nymph and adult may both do so. Infection taken in during the nymphal engorgement can be transmitted later by the adult stage. In the nymphs (unfed) bred from infected mothers, there occur in the salivary cells swarms of small,

* Journ. Hygiene, vi. (1906) pp. 586–650 (3 pls.).
† Brit. Med. Journ., Jan. 1907, pp. 76–8 (1 fig.).

rounded, oval, or pear-shaped forms, the result of fission of the ookinete (? sporoblasts). Should the nymph bite, these are capable of development in the dog, but within the nymph during its metamorphosis there is a further division into bodies resembling the dog piroplasma (? sporozoites), which appear in the salivary cells of the adult. Thus the salivary cells of the nymph and of the adult are stocked, each with a distinct stage of the organism.

Hæmatozoa of Bat.* — T. Bowhill records the occurrence in *Acanthia pipistrelli* Jenyns, in South Africa of both intra- and extra-corpuscular blood parasites. The former were observed to be coarsely pigmented, and appeared to resemble those described by Dionisi in Italian bats. The extra-corpuscular forms were trypanosoma-like in structure; in one there appeared to be both a long and a short flagellum.

Protozoa of Mosquitos in India.†—Ronald Ross gives a summary of various protozoa observed by him in mosquitos in India. In particular he calls attention to *Chrithidia*, which occurs in the gut of *Culex fatigans*, and suggests that these may have been the trypanosoma-like bodies observed by Schaudinn in *Culex pipiens*, and which the latter regarded as a stage in the life-history of the *Halteridium* of *Athene noctuæ*. The author doubts the theory that the Hæmosporidia are specifically connected with the Trypanosomes and Spirochætes, and suggests that the inquiry into this matter should be renewed.

Protozoan Parasite of Leucocytes.‡—P. N. Gerrard and C. M. Wenyon give an account of a protozoon infesting the polymorphonuclear leucocytes of a dog at Krian, in the Federated Malay States. It occurred within a cyst, and is probably identical with that discovered by Bentley in dogs in Assam. It appears to be nearly related to the Hæmogregarines.

Herpetomonas Parasites in Fleas.§—Andrew Balfour gives a brief account of various phases of a *Herpetomonas*-like parasite in the gut of *Pulex cleopatræ* Roths. They were found in both sexes, and in fleas, which had fed on blood infected with *Hæmogregarina balfouri* Laveran, and also in examples which had not so fed. Rosette, vermicule, and trypanosoma-like forms were observed.

Parasitology of Sudan.‖—Andrew Balfour, in an important report, deals with the parasitology of the Sudan. An account is given of exterminating mosquito work, and along with it records of new genera and species. As regards the malaria parasites, the quartan form is recorded as occurring with considerable frequency, but is less common than the other two forms. Tsetse flies, both *Glossina morsitans* and *G. palpalis*, are reported for Sudan territory, the former from Southern Kordofan and the latter in large numbers to the south-east of Mvolo. In this connection a Commission has been appointed to investigate the possibility of the extension of sleeping sickness into Sudan territory.

* Journ. Hygiene, vi. (1906) pp. 246–7 (1 pl.).
† Tom. cit., pp. 96–7, 101–9. ‡ Tom. cit., pp. 229–36 (1 pl. and 1 fig.).
§ Tom. cit., pp. 652–5 (1 pl.).
‖ Second Report, Wellcome Research Laboratories, Gordon Memorial College, Khartoum, 1906, 255 pp.

A considerable number of biting and noxious Diptera are recorded, the new species being described by E. E. Austen. F. V. Theobald gives an account of the new genera and species, with their localities, of the mosquitos, and supplies interesting notes regarding various human, animal, and vegetable pests, e.g. the maggot fly, *Wengalia depressa*, whose larva was found under the skin of a native, and the Congo floor maggot, *Auchmeromyia luteola* Fabr., whose maggots occur in native huts, living in cracks in the mud. These they leave at night to suck the natives' blood, and then return to their shelter. A. Balfour describes a Hæmogregarine, *H. balfouri* Laveran, from the blood and liver-cells of the jerboa, *Jaculus gordoni*, with notes on the schizogony, and discusses a probable cycle of development of the same organism within the jerboa flea, *Pulex cleopatræ*. He also describes a new leucocytozoon, *Leucocytozoa muris* sp. n., from *Mus decumanus*, at Khartoum, which appears to be closely allied to one described by Patton from an Indian palm-squirrel.

Trypanosomes appear to occur to a considerable extent in the southern Sudan (south of the 10th parallel of latitude). In cattle, *T. nanum* produces a disease which runs a chronic course, and may prove fatal. It is a small Trypanosome, not very active; the free part of the flagellum is extremely short or absent; the posterior extremity is conical. In mules, two types exist; one is probably identical with *T. dimorphum*, of Senegambia. The disease produced is invariably acute and fatal. The other form closely resembles *T. nanum*; mules affected with it may apparently recover under favourable conditions. Associated with these were found in gastric lesions, spirilla, which never occurred in the stomach or intestines of uninfected animals. In donkeys, a Trypanosome suggestive of *T. brucei* was observed. Tsetse flies are the chief, and probably the only carriers of these Trypanosomes. Stomoxys appears to play no part in the distribution of the disease.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Cytology of the Cyanophyceæ.—A. Guilliermond * has investigated the Cyanophyceæ with reference to (1) the cortical layer, (2) the central body, (3) the origin of the metachromatic corpuscles. The author regards the cortical layer as the cytoplasm, holding in solution a blue pigment, but he disagrees with Fischer in regarding the colouring matter as of the nature of a chromatophore. The central body may be regarded as a true chromatic network, or, in other words, as a nucleus without a membrane. The metachromatic bodies have the same characters as those of the Fungi, and their origin is clearly nuclear.

N. L. Gardner † has investigated the Cyanophyceæ with special reference to the nucleus. The investigation shows the presence of a series of nuclear structures, varying from a very simple form of nucleus, which is scarcely delimited from the surrounding cytoplasm, to a highly differentiated distinct nucleus. The simplest nuclear structures divide amitotically, but the higher forms show a primitive form of mitosis, and in structure resemble the nucleus of the Chlorophyceæ. Under slow desiccation, the nucleus may assume a resting condition. Definitely organised chromatophores are absent, and there is no evidence of continuity between the vegetative cells. Change in habitat does not produce change in cytological characters.

Epidermis of Terrestrial Plants.‡—L. Géneau de Lamarlière, continuing his investigations upon the epidermis, now describes his results with terrestrial plants. He divides the latter into two classes; the first includes such plants as *Cheiranthus Cheiri*, *Brassica oleracea*, etc., and here the epidermis bears a close resemblance to that of aquatics, both in structure and chemical composition. The second class, which is connected with the first by many intermediate forms, includes such plants as *Ruta graveolens*, *Euonymus japonica*, *Bupleurum fruticosum*, etc.; here, cutinisation extends almost to the external membrane, but the colour reactions of the pectic and accompanying compounds are masked, except in contact with the innermost membrane. The epicuticle can be distinguished, and has the same constitution as in the preceding groups.

* Rev. Gén. Bot., xviii. (1906) pp. 447–65 (2 pls. 1 fig.).
† Univ. of California Publications (Botany), ii. (1906) pp. 237–96 (pls. 21–6).
‡ Rev. Gén. Bot., xviii. (1906) pp. 372–8.

Structure and Development.

Vegetative.

Asymmetry of Compound Leaves.* — Ph. van Tieghem has examined the lateral leaflets and the stipules of numerous types of compound leaves, and is led to the following conclusions. Whatever may be the number, form, size, and arrangement of such leaflets, they are asymmetrical; when stipules also occur, they share in this want of symmetry. The asymmetry of the leaflets is so arranged as to preserve the bilateral symmetry of the entire leaf. More frequently the lower portion of the leaflet or stipule is the more highly developed, but the reverse may be the case. Sometimes the upper portion of the leaflets is the greater, while the stipules of the same leaf are larger towards the base, and *vice versa*. Both kinds of asymmetry occur side by side in the same families. Stipules, whether of a simple or of a compound leaf, are always asymmetrical.

Intracellular Formations in Rhamnus cathartica L.†—W. Tichomirow has investigated the intracellular formations of the leaf of *Rhamnus cathartica*, and finds them precisely similar to those of the fruit of the same plant. These formations are cylindrical, and are found in the palisade layer, in the neighbourhood of the vascular bundles, and in the spongy mesophyll.

The author also finds that in the fruit, the intracellular formations, which are colourless during life, become bright red when exposed to the air, owing to the presence of an oxydase.

Structural Account of Aptosimum Burch. and Peliostomum E. Mey.‡—Emil Weber describes the results of his investigations, partly structural, partly systematic, on these two genera of South African plants, members of the order Scrophulariaceæ. *Aptosimum*, the larger of the two genera dealt with, now numbers twenty-eight species, all, with one exception, natives of Africa south of the equator (Angola, German S.W. Africa, Rhodesia, Transvaal, Orange River Colony, and the Cape). None have yet been found in Natal. They are, therefore, xerophytes, and their structure clearly shows adaptation to xerophytic conditions. Bentham's classification into two groups, spine-bearing and unarmed, the author finds to stand the test of microscopic examination, since only two of the nineteen species of the first group show anatomical peculiarities markedly different from the rest. The epiderm (always of one layer) of the leaf has a thick outer wall, in some cases strongly, in others slightly cuticularised. The hypoderm above and under the midrib extends up to the epiderm, its outermost cells being collenchymatous. Trichomes afford help in the dissemination of species. The assimilation tissue usually consists, on both sides of the leaf, of short palisade cells with but few intercellular spaces. Stomata, rarely sunk below the surface, are found in equal numbers on both sides. The structure of the midrib is important in classification. In the sub-genus *Spinosa*, the

* Ann. Sci. Nat., iv. (1906) pp. 211–22.
† Comptes Rendus, cxliii. (1906) pp. 922–4.
‡ Beih. Bot. Centralbl., xxi. 2te Abt. (1906) pp. 1–101 (3 pls.).

chief anatomical mark is the greatly developed xylem, the chief elements in which are very numerous prosenchymatous cells ("libriform cells") with the appearance of bast fibres, having imperforate transverse walls often so thickened that the lumen is almost obliterated. After a time the soft parts of the leaf are shed, leaving the persistent xylem in the form of a spine. The xylem proper consists of tracheæ frequently accompanied by tracheides, especially at the ends of the nerves. Bast fibres always accompany the leptom in some part of its course, though in some species they are found only at the base of the leaf. The species of the sub-genus *Inermia* have a much less strongly developed xylem, and the leaf-base is either without libriform cells, or, if present, they run isolated from one another. In this sub-genus the leaf is shed as a whole, and consequently there are no spines.

In all species the stem consists of cork, cortical parenchyme, phloem, xylem, and pith. The cork is sometimes greatly developed, and the walls of the cortical parenchyma are of pure cellulose. Bast fibres are in small bundles, or form a complete ring on the outer side of the phloem. The xylem is made up of tracheæ, tracheides, and libriform elements; but at the tips of the branches the hadrom forms no complete ring, but usually appears as four bundles surrounded by fundamental tissue, bundles from which the leaf-traces originate. One species (*A. nanum* Engl.) has its xylem always separated into five masses, with medullary rays between. The 4–6 innermost cell-layers of the capsule-wall consist of isodiametral lignified cells (sclereides) with radial walls. This is the conducting tissue, and is accompanied on its outer side by bundles of libriform elements. The sclereides swell up in water, and in consequence of the resistance offered by the libriform bundles, the capsule opens.

Peliostomum, with six species, inhabits the Cape, the extra-tropical part of German S.W. Africa, the Kalahari Desert, Transvaal, Orange River Colony, and Natal. The leaf-structure is much like that of *Aptosimum*, but the hadrom is semilunar, with a small crescent of leptom on its underside. The hadrom consists of tracheides, with woody parenchyme in some species. There is usually no special mechanical tissue here. In the branches is a more or less broken ring of bast fibres at the outer border of the leptom. The xylem consists of tracheæ, tracheides, and wood prosenchyme. Sections at the base of a branch show the same structure as at the tip. The capsule has no libriform cells in its wall, and it does not open hygroscopically.

The rest of this excellent memoir is devoted to detailed examination of the several species.

Reproductive.

Reproduction of the Fig Tree.*—Leclerc du Sablon has investigated the two kinds of flowers of the Fig tree (*Caprificus*), with special reference to their symbiotic relationship to Blastaphaga. The author finds that, contrary to previous ideas, not only do the autumn figs form seeds, but also those produced in winter. The formation of seeds by

* Comptes Rendus, cxliii. (1906) pp. 756–7.

short-styled flowers, shows that the specialisation of two sorts of female flowers is not complete, for the short-styled flowers are just as well fitted for producing seed as for nourishing Blastaphaga. The plant is monœcious with normally constituted male and female flowers. The summer figs inclose male flowers, which produce pollen, and female flowers, which nourish Blastaphaga; the latter passes out and carries either pollen or its own eggs to flowers inclosed in figs of the second or third crop, but the flowers which form seeds are of exactly the same constitution as those which develop galls.

Pollen-grain.*. — Germano Vert calls attention to the similarity existing between pollen-grains and spores. After briefly noting the differences between multiplication and sexual reproduction, he points out that the methods of fertilisation which obtain among higher plants are quite different from what might be expected from a study of lower forms. The author makes a comparison between the structure and appearance of the spore and the pollen-grain, and notes the similarity in the manner of germination, and the growth of the hypha from the spore and the tube from the pollen-grain. Finally, he shows that the difficulty encountered by the male element in reaching the female, has been met by utilising an element possessed by the vegetative portion of the organism, viz. the spore.

Physiology.

Nutrition and Growth.

Respiration of Seeds in Latent Condition.† — P. Becquerel has made two series of experiments upon the respiration of seeds. In the first he used seeds in their natural dry state; in the second he used seeds which had undergone the maximum amount of desiccation. The author finds that, generally, when left for a sufficiently long time, seeds do give off a trace of CO_2 and absorb a small amount of oxygen, when placed in the dark in their naturally dry state. Light greatly increases this gaseous exchange, owing to its power of promoting oxidation.

The teguments of the seed play a most important part; in some cases, e.g. *Ricinus*, the gaseous exchange of the teguments was greater than that of the seeds from which they had been removed. Lastly, dehydration of the seeds is an important factor; in same cases the absence of moisture entirely prevents gaseous exchange.

Increase in Growth of Trees.‡—François Köressi has studied the laws of the increase in volume of trees, and finds that this increase is a linear function of the time of growth. The increase in volume is proportional to the cube of the time, under constant biologic conditions, and may be represented by $V = Mt^3$. Owing to the variation of biologic conditious, M will not be a constant, but will itself be a function of the time. The function Mt is subject to two kinds of variations, viz. (1) fluctuation due to variation in climatic conditions; (2) decrease due to the constant pressure exerted by the exterior annual rings upon the internal ones.

* Comptes Rendus, cxliii. (1906) pp. 977–9. † Tom. cit., pp. 974–7.
‡ Op. cit, cxlii. (1906) pp. 1430–2.

Chemical Changes.

Action of Water on Aleurone Grains.* — H. Joffrin, as a result of various experiments, concludes that the modification of aleurone grains in the white lupin is the result of the absorption of a fixed, optimum quantity of water, the process being hindered by diminution or excess of this quantity, which appears to be equal to the dry weight of seed acted upon. The rapidity of transformation proves that the reaction is of a chemical nature, not diastasic. The author puts forward the hypothesis that the cells contain mineral substances which are brought into solutions of a definite strength, and these are capable of acting upon the aleurone grains.

Leaf Coloration.†—A. Gautier, in connection with a recent paper published by M. Mirande, draws attention to his former work upon leaf-coloration produced by artificial means, e.g. wounding, and also that which takes place normally in autumn. He has proved that the red colouring matter is neither azotic nor phosphoric in nature, and therefore cannot be a degradation product of chlorophyll. In the vine the colouring matter is formed from acid-phenols, and is of the nature of a tannin. It differs somewhat in the grape-ivy. The author believes that the various shades of red in autumnal leaves are due to the oxidation of a chromogen produced in the leaves ; also that the various pigments vary with each species of plant, just as do the colours of fruits.

Plant Mutation.‡ — The late H. M. Slade began an interesting series of investigations upon the action of alkaloids on metabolic processes. His experiments show that the alkaloid characteristic of a family aids the diastatic activity of the members of that family, and this favouring action appears to run parallel with the natural relation of the family. Alkaloids of distant families retard diastatic action. Variable families appear to be hindered by alkaloids in this respect. These facts were used successfully in promoting the germination of the seeds of *Schizanthus*, Tomato, *Digitalis*, etc. On the contrary, the alkaloids which favoured diastatic reaction hindered the oxidase. Since alkaloids aid oxidation, they probably increase the oxidising capacity of the plant-cell, where the latter lacks oxidases.

General.

Variation in Ophrys aranifera§.— E. D. Kalkhoff has discovered two remarkable instances of malformation in the flowers of *Ophrys aranifera*. The first specimen had two flowers of normal size and colour, but the lip was absent, and the column was modified. In the lower flower the rostrum also varied, while the stamens and pollen were absent. The second specimen, growing in another district, had four flowers, in three of which the column and stamens were normal,

* Rev. Gén. Bot., xviii. (1906) pp. 327–31 (figs. 1–4).
† Comptes Rendus, cxliii. (1906) pp. 490–1.
‡ Amer. Journ. Pharm., 1906, pp. 311–17.
§ Verh. Zool.-Bot. Gesell., lxi. (1906) pp. 434–6 (1 pl. and 2 figs.).

while the fourth had a truncated column. The perianth also varied, both in number of leaves and also in the development of certain coloured patches. Two of the flowers bore little scales at the base of the outer whorl of the perianth, while at the base of the column were brown specks, which suggested the action of a fungus upon the tissues. No such suggestion of the cause of malformation can be offered in the first case.

Modifications of the Flowers of Teucrium due to Larvæ of Copium.* C. Houard gives an account of the modifications in the flowers of *Teucrium Chamædrys* and *T. montanum*, brought about by the larvæ of *Copium*. The protective whorls are so modified that they resemble a vegetative growth; this is due to the thickening of the corolla-wall, and to the formation of nutritive tissue, which is of use to the developing larvæ. The influence of gall-formation is most marked upon the reproductive whorls, where it produces the effects characteristic of parasitic degeneration; each species of Germander has its own peculiar modifications. In *T. montanum* all the floral whorls share in the change; the corolla forms the much-thickened wall of the gall, while the reproductive whorls atrophy.

Composition of Sap of Roots.† — G. André has investigated the composition of sap extracted from roots by bruising and pressure. Specimens of Jerusalem artichoke, carrot, and *Phytolacca decandra* were gathered at different periods of growth, and subjected to gradually increased pressures. It is found that the composition of the juice so obtained is nearly constant and is independent of the pressure. The concentration, on the contrary, varies with the pressure, being greater when the pressure is small, and decreasing as the pressure increases.

Seeds and Inflorescence of Callipteris.‡—F. Grand'Eury has examined the flora of the mines of Margenne and Télots, and is convinced that the seeds which always accompany the leaves of *Callipteris conferta*, and which hitherto have been known as *Carpolithes variabilis*, are actually the seeds of *Callipteris*. They are round, ovoid, or elliptical, with a thin testa, and striations diverging from the base, and converging towards the apex. There is no line of dehiscence, and they were probably of the nature of berries, and hence the most simple of Pteridosperm seeds. The author has also examined some curious male organs, recalling a very enlarged type of *Crossotheca*, which he also considers as belonging to *Callipteris*, although there is no positive proof that this is the case.

Inflorescences of the Seed-bearing "Ferns." § — F. Grand'Eury contributes the results of investigations upon the inflorescences of the seed-bearing Ferns. After remarking upon the round seeds, with thin testa, similar to those of *Sphærospermum* Br., which so often accompany *Callipteridium*, the author proceeds to describe two kinds of inflorescences which abound in the Upper Culm of Brittany, in company with seeds and fronds of *Sphenopteris*. The first consists of involucres with spread-

* Comptes Rendus, cxliii. (1906) pp. 927–9.
† Tom. cit., pp. 972–4.
‡ Tom. cit., pp. 664–6.
§ Tom. cit., pp. 761–4.

ing lobes, sometimes surrounding little ridged seeds, and borne at the end of short, equal pedicels. This inflorescence is like that of *Calymmatotheca*. The second has seeds of several kinds, terminal on long, unequal, branched pedicels, which are themselves the final branches of certain modified branches of *Sphenopteris*; this type resembles the inflorescence of *Lapsana communis*. The author has also examined the seeds of *Odontopteris Reichiana*, *Linopteris* Br., and *Neuropteris cordata* Br. The inflorescences of the latter were probably large, compound spikes, loaded with distichous seeds.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

British Ferns.—D. S. Fish * gives an account of the stations where *Adiantum capillus-veneris* is found in Ireland. It occurs profusely in fissures of limestone beds in Co. Clare, where it obtains the necessary mositure, heat and shade, and shelter from the winds; also on dry limestone rocks near Roundstone, Connemara. J. Britten and A. M. Geldart † cite some records of the occurrence of *Cystopteris fragilis* at Bungay and Yoxford, in Suffolk. W. Young ‡ gathered in Corrie Ceann-mor, South Aberdeen, a strong plant of *Cystopteris fragilis*, pronounced to be the var. *sempervirens*, which has been regarded as a doubtful native of Britain. Under cultivation the plant maintained its evergreen character throughout the winter, not dying with the first frosts. It is certainly a native of Madeira, but its British stations at Tunbridge Wells and in Devonshire are open to suspicion of an importation of the plants.

Allosurus crispus.—J. Adams § records the occurrence of *Allosurus crispus* at two stations in Co. Wicklow; previously it was not known to occur in Ireland south of a line drawn from Dundalk to Sligo. P. Q. Keegan,‖ in treating of the chemistry of some common plants, gives an account of the chief constituents and extractives of *Allosurus crispus*, and compares them with those of *Pteris aquilina*. The remarkable feature of the plant is the large quantity of soluble salts, conjointly with the considerable amount of silica.

Pteridophytes of Ascension.¶—R. N. Rudmose Brown gives a list of seven ferns and a *Lycopodium* collected by him on Elliott's Pass, at an altitude of 2000 ft. on Green Mountain, in the island of Ascension. Two of the species are new records for the island.

Distribution of Ferns in South Africa.**—T. R. Sim has issued a paper supplementing his "Ferns of South Africa," 1892. He records seven additional Pteridophytes for Cape Colony, Natal, and Zululand,

* Trans. Proc. Bot. Soc. Edinburgh, xxxiii. (1906) pp. 196–8.
† Journ. of Bot., xlv. (1907) pp. 33, 71.
‡ Trans. Proc. Bot. Soc. Edinburgh, xxiii. (1906) pp. 192–4.
§ Irish Naturalist, xv. (1906) p. 233. ‖ Naturalist, 1907, p. 25.
¶ Trans. Proc. Bot. Soc. Edinburgh, xxiii. (1906) pp. 202–3.
** Trans. S. African Phil. Soc., xvi. (1906) pp. 267–300 (2 pls.).

and numerous additions for Orange River Colony, Transvaal, and Rhodesia. Two species are new to science. In all he records 212 species for South Africa. In Natal are found 147 species. Proper to Natal are 15 species, to Transvaal 7, to Rhodesia 11, to Zambesia 15, to Orange River Colony 1, and to the western districts of Cape Colony 17.

North American Ferns.—A. S. Pease and A. H. Moore* point out that American specimens of *Botrychium lanceolatum* differ from the European in having a less coarse habit and sterile segments more distant and narrow, and they make a new variety of the American plant.

C. H. Bissall† announces that the rare *Asplenium pinnatifidum* Nutt., first recorded for New England in 1902, has been found in Connecticut again, further to the north-east. It was associated with *A. platyneuron* and *Camptosorus rhizophyllus*.

Ferns of South Brasil.‡—E. Rosenstock publishes a second contribution to our knowledge of South Brazilian ferns. In the two years which have elapsed since his last paper appeared, a rich supply of material has enabled him to add considerably to the number of species for that region, as well as to describe novelties and to revise his conclusions on certain species treated of in his former paper. The nomenclature followed is that of C. Christensen's "Index Filicum." Where the author deems it advisable, he has added the name under which the species appears in Baker's Synopsis. In the present instalment he enumerates 359 species, all critically annotated to a greater or less extent. Among them are 26 species new to science, and a large number of new varieties and forms.

Anatomy of Sigillaria elegans.§—R. Kidston gives an acconnt of the internal structure of *Sigillaria elegans* of Brongniart's "Histoire des Végétaux fossiles," prefaced by a brief summary of the literature dealing with the internal structure of *Sigillaria*, and some general remarks on the classification of the genus. In his description of *S. elegans* the author gives details as to the general appearance of the specimen, the primary or centripetal xylem, secondary or centrifugal xylem, leaf-traces, cortex, cone-scars, adding a series of photographic illustrations. He appends a table showing the age of the rocks which have yielded *Sigillaria*, the internal structure of the specimens, and a few of their more prominent characters.

Classification of French Ferns by Anatomy.‖—F. Pelourde has essayed to draw up a classification of the ferns of France, based on the anatomical structure of the root, petiole, and stem, adding observations on certain exotic species where comparison seemed necessary. After giving a résumé of previous work, he shows by his own studies of the various species that the root and petiole present differences in their structure which are of great systematic value. In the root, the presence or absence of a sclerotic ring round the endodermis, or of a

* Rhodora, viii. (1906) p. 229. † Tom. cit., pp. 230.
‡ Hedwigia, xlvi. (1906) pp. 57–167.
§ Trans. Roy. Soc. Edinburgh, xli. (1906) pp. 533–50 (3 pls.).
‖ Ann. Sci. Nat., sér. 9, iv. (1906) pp. 281–372.

ring of cells with strongly thickened but not sclerotic walls, and sometimes the form of the central cylinder, are extremely useful characters. In the petiole the number of bundles, and especially the form of the xylem in them, the presence or absence of sclerotic strands, or of a sclerotic sheath, constitute characters of first importance for determining genera, and sometimes species. The structure of the stem is characteristic only in exceptional cases; as a rule, the bundles form an inextricable network. In some cases these anatomical characters agree with the morphological facts, as, for instance, in *Polypodium*, *Adiantum*, *Grammitis*, *Osmunda*. On the other hand, these characters indicate that *Scolopendrium* should be associated in one and the same tribe with *Asplenium* and *Ceterach*, and that *Lomaria* and *Blechnum* should not only be put into one and the same tribe, but even united into one genus. Again, the indication is that *Athyrium* should be split off from *Asplenium*, and *Phegopteris* from *Polypodium*, and *Pteridium* from *Pteris*. Two well marked sections are indicated in *Notochlæna*. The species of *Aspidium*, *Nephrodium*, *Polystichum*, should be arranged in two groups; in one the root has a sclerotic sheath, and the petiole contains several bundles, of which the two principle ones have the xylem shaped like a "cornu"; in the other the root has no such sheath, and the petiole contains two bundles only, with the xylem shaped like a "hippocampus." The first is called *Aspidium* by the author, the second is *Nephrodium*. Again, some species are more readily distinguished from one another by the anatomy of root and petiole than by morphological difference. Finally, the author provides an illustrated key to the anatomical differences of the species of ferns proper to France.

Bryophyta.

(By A. Gepp.)

British Hepaticæ.*—S. M. Macvicar publishes critical notes on new and rare British Hepaticæ. (1) *Riccia Huebeneriana* Linden. var. *pseudo-Frostii* Schiffn. was found at Crowborough and Horsted Keynes, Sussex, by W. E. Nicholson. According to Schiffner, it is worthy of specific rank. Owing to its large air-cavities, it might be confused with *R. crystallina*; but the latter is always green, and never violet. (2) *Lophozia badensis* Schiffner has been much confused with *L. turbinata* Steph., and to some extent with small forms of *L. Muelleri*. This confusion has been cleared up by Schiffner. Macvicar cites stations for *L. badensis* in Yorkshire and Scotland, and describes the salient points of all three species, and shows how the *Jungermannia acuta* of Lindenberg—a mixed species—has added to the confusion. (3) *Prionolobus striatulus* Schiffn. has been gathered in Lanarkshire by Macvicar, where it occurs at an altitude of 1900 ft., growing on masses of decaying *Sphagnum*, associated with *Vaccinium Myrtillus*, *Empetrum*, and *Polytrichum*. It has been found in Scandinavia and France. In the latter country it has been mistaken for *Cephalozia elachista*, which, according to Douin, has not been found in France. Lately *C. elachista* has been found in Sussex by Nicholson, the only previous British station

* Journ. of Bot., xlv. (1907) pp. 63–6.

being in Ireland. (4) *Cephaloziella integerrima* Warnst. was found by Nicholson in Sussex at two stations. Macvicar shows how it differs from *C. Bryhnii*, and resembles *C. piriflora* Douin.

Rhacomitrium ramulosum: a British Moss.*—W. Young gives an account of a moss which he gathered on Craig Mohr, Perth, in July 1898, and which, after being referred for some years to *R. sudeticum* and *R. heterostichum* var. *gracilescens*, is now recognised to be *R. ramulosum* Lindb.—a moss long supposed to be a doubtful native, having been recorded seventy years ago by Hooker from the Highlands, but without special habitat. Recently, however, it was gathered by Stirton in Lewis, and by Lillie in Caithness. A critical note by Dixon is added.

Bryological Work of William Mitten.†—W. E. Nicholson gives a sketch of the life of William Mitten (b. 1819; d. 1906), who devoted the leisure hours of his long life to the study of the Muscineæ of Britain and of the whole world. In the appended bibliography fifty-seven of his bryological contributions are cited, treating of bryological collections from all parts. His most important work, the "Musci Austro-Americani," occupies the twelfth volume of the Journal of the Linnean Society. Of great importance also are his enumerations of the mosses and hepatics of India, New Zealand, Tasmania, Samoa, Ceylon, of the 'Challenger' and Transit of Venus Expeditions.

Census of Australian Mosses.‡—W. W. Watts and T. Whitelegge have compiled a classified catalogue of the acrocarpous mosses of Australia and Tasmania, collated from available publications and herbaria. The catalogue comprises 918 species, 90 of which appear to be new to science, but are published without descriptions. Indeed, many of the new species are known only by name in Australia, having been determined in Europe. The compilation of the list was rendered the more difficult by the inaccessibility of descriptions and specimens, and by the different principles of determination and classification adopted by specialists. Hence the present census is intended as a working list. A bibliography of papers on Australian mosses is appended.

Mosses from Alaska.§—J. Cardot and T. Thériot describe a small but very interesting collection of mosses made by W. A. Setchell and others in the summer of 1899. It comprises 63 species and several varieties, of which 4 species are new to science and 6 new to Alaska. The 4 new species are (1) *Orthotrichum cancellatum*, nearly related to *O. fenestratum*, but differing in its smaller size, shorter stems, shorter and more papillose leaves and immersed capsule, sulcate when dry; (2) *Bryum pseudo-Græfianum*, which differs from *B. Græfianum* Schlieph. and *B. Kaurinianum* Warnst. by its paler capsule and its shorter, smaller, and more shortly acuminate leaves, with the costa not so longly

* Trans. Proc. Bot. Soc. Edinburgh, xxiii. (1906) pp. 190–1.
† Bryologist, x. (1907) pp. 1–5 (portrait). See also Journ. of Bot. xliv. (1906) pp. 329–32 (portrait).
‡ Proc. Linn. Soc. New South Wales, 1902, part 3, suppl., pp. 1–90; 1905, part 4, suppl. pp. 91–168.
§ Univ. California Publications, ii. (1906) pp. 297–308 (2 pls.).

excurrent; (3) *Bryum Setchellii*, closely allied to *B. agattuense* Phil., from which it is distinguished by its less obtuse leaves, its numerous slender, brittle branches, and more evolute peristome; (4) *Hypnum pseudo-sarmentosum*, distinguished from *H. sarmentosum* Wahl. by its acuminate-acute leaves.

North American Muscineæ.—A. J. Grout * publishes some notes on Vermont Bryophytes, chiefly collected on and near Mt. Mansfield. Among the species recorded are *Tayloria tenuis*, *Schistostega*, *Swartzia montana*, *Amphidium lapponicum*, *Rhabdoweisia denticulata*, *Cynodontium gracilescens*, *Amblystegium racillans*, *Plagiothecium elegans*, *Pohlia cruda*, and remarkably varying forms of *Pohlia nutans*.

E. G. Britton † makes her seventh contribution of notes on nomenclature, treating of the North American genera of Neckeraceæ, included in Engler and Prantl's "Pflanzenfamilien."

C. C. Haynes ‡ gives figures of ten species of *Lophozia*, to illustrate descriptions borrowed from A. W. Evans's "Notes on New England Hepaticæ."

J. M. Holzinger § has for twelve years studied the natural growth of *Physcomitrium immersum*, and has never succeeded in finding more than a few plants of it in a tuft. It usually occurs isolated among the following hepatics—terrestrial forms of *Ricciocarpus natans* and *R. fluitans*, associated with *Anthoceros Macounii*; and with it often occurs *Ephemerum crassinervium*, with abundant protonemata.

Vancouver Hepaticæ.‖—A. W. Evans gives a list of 71 hepaticæ of Vancouver Island. In an historical survey he shows that the first records were three species reported by Mitten in 1859; in 1890 55 species were recorded by Pearson, which total was raised to 66 by Underwood in 1902. Of the 71 species reported from the island by Evans, 54 are common to Europe, 43 to New England, and 14 are confined to the Pacific Coast of North America.

South American Mosses.¶—I. Thériot gives a list of ten mosses collected near Bogota, in New Granada, by Père Apollinaire-Marie. There are two new species of *Leptodontium*, which are described by Brotherus and figured by Thériot.

Bryophyta of Ascension.**—R. N. Rudmose Brown gives a list of five mosses and five hepatics collected by him on Elliott's Pass, at an altitude of 2000 ft., on Green Mountain, in the Island of Ascension. One of the hepatics is a new record for the island.

Moss-flora of Leipzig.††—W. Mönkemeyer has studied the moss-flora of the district round Leipzig. Until quite recently there was a flora of about 100 Muscineæ in a small area on and about an outcrop of clay at Gautzsch. Four new species of *Bryum* from that place were described by Hagen in 1904, and a wealth of forms of *Drepanocladus* and other

* Bryologist, x. (1907) pp. 6–7.
† Tom. cit., pp. 7–8.
‡ Tom. cit., pp. 9–12.
§ Tom. cit., p. 13.
‖ Postelsia, 1906, pp. 215–33.
¶ Bull. Acad. Internat. Géogr. Bot., xv. (1006) pp. 78–80 (1 pl.).
** Trans. Proc. Bot. Soc. Edinburgh, xxiii. (1906) pp. 203–4.
†† SB. Natur. Gesell. (Leipzig, 1906) 42 pp.

Hypnaceæ were forthcoming. This station is now nearly destroyed by building, etc. After a close study of *Drepanocladus*, the author finds himself in sympathy with Renauld as to the main treatment of the group. He gives details as to the grouping of the forms, though the number of intermediates is so vast that they tend to link all the forms into one big species. In concluding his paper, the author adds a list of 38 species of historic interest, first recorded from Saxony by Schreber or Hedwig; 20 of these were collected close to Leipzig.

Monograph of Lophocolea.*—F. Stephani gives descriptions of 27 species of *Lophocolea*, eight of which are new to science. All the species described were collected in Central or South America.

Nematode Galls on Liverworts.†—C. Warnstorf records the first occurrence of Nematode galls observed by him on an hepatic. They formed dark-green spherical heads on the apex of stems of *Cephalozia connivens* f. *laxa*. They are composed of densely-crowded, superposed, lobed, ciliated, degenerate leaves, and contained one or two *Anguillula*-worms. Whether they are the same as those occurring in moss-galls is at present unknown.

Contractile Tissues of Mosses.‡—W. Lorch has investigated the movements and shrivelling of the stems and leaves of several mosses caused by a loss of water. These phenomena occur in a marked degree in *Leptodon*, a genus of Neckeraceæ. The author has specially studied these movements in *L. Smithii*, and found in the creeping primary stem and in its ascending branches a band of thick-walled cells on the dorsal side which contract when dried and produce the movements and coiling. In the leaves of *Catharinea Hausknechtii* he found that the cells on each side of the costa exert a contractile force and render the lamina undulate. It is presumably the cell-walls and not the cell-contents that effect the contraction. He examined *Dawsonia superba* and other Polytricheæ of the type of *Polytrichum piliferum*, and found in all those which possess a distinct leaf-sheath a well-marked contractile tissue which probably belongs rather to the lamina than to the sheath.

Stem Leaves of Sphagnum.§—W. Lorch discusses the mechanical system of the stem-leaves of *Sphagnum*, which he holds to be as highly developed as the branch-leaves, despite the opinion of Russow. He considers the development of the strengthening ribs and the pores of the hyaline cells of the leaf and their relation to one another. The membranes of the chlorophyll-cells serve to stiffen the leaf. The stiffening apparatus is more highly developed in the upper than in the basal hyaline cells of the leaf. The difference in shape of the upper hyaline cells as compared with the lower is explained on biological grounds. It is of great importance that the terminal bud should be protected from drying up; and it is closely covered with imbricating stem-leaves, the upper outer sides of which are exposed to incident water, for the capillary absorption of which, by means of minute pores, the upper

* Bull. Herb. Boissier, vii. (1907) pp. 59–72.
† Allg. Bot. Zeitschr., xii. (1906) p. 194 (figs.).
‡ Flora, xcvii. (1907) pp. 76–95 (figs.).
§ Tom. cit., pp. 96–106 (figs.).

hyaline cells are specially adapted. The terminal bud is therefore clothed with a tissue so provided with pores that it easily absorbs water and stubbornly retains it.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

South American Fresh-water Algæ.*— O. Borge adds largely to our knowledge of the fresh-water algæ of Tierra del Fuego and Desolation Island as the result of his examination of the collections made there by Dusén in 1906. Up to the present time, the number of species recorded from this district was 33, and the present paper brings the total to 77. Six new species are described, as well as several new varieties, which are figured.

Corean Marine Algæ.† — A. D. Cotton reports on several small collections of marine algæ from Fusan and Wonsen, and records 32 species, besides several which were too incomplete to name specifically, and some critical species which are being held over for a future communication. The character of the flora resembles that of Japan, but some of the algæ have not yet been recorded from that island, and two are new species, *Ceramium hamatum* and *Dumontia simplex*. Critical notes are made on some of the records, including *Cutleria cylindrica* Okam., and *Grateloupia divaricata* Okam.

Seaweed Industry of Japan.‡—At the request of the British Foreign Office, a report on this subject was drawn up by C. J. Davidson, giving full details of the uses to which algæ are put, the manner of collection and preparation, etc., as well as the total amount and value of the material prepared in a certain time. The author states that more than fifty-one species are employed in Japan for various useful purposes, and their collection and subsequent treatment form one of the most prominent industries of the Japanese Empire. They are used as food, and are made into plaster, glue, and starch; they serve as manure, and from them isinglass is prepared and iodine is extracted. The preparations specially dealt with in this report are kanten (isinglass), kombu (kelp), amanori (laver), funori (seaweed glue), and iodine. The author describes in detail the methods of preparation, and gives lists of the species employed in the work.

Lamprothamnus alopecuroides.§—M. McNicol has made a special study of this member of the Characeæ, which differs from *Tolypellopsis* in the possession of stipular cells, and from *Lycnothamnus* and *Chara* in having the oogonia below the antheridia. She treats of the distribution, general features, bulbils, tubercles, pro-embryos, and abnormal plants. She has found that *L. alopecuroides* will grow in jars under cultivation for years, provided the water is changed from time to time,

* Botaniska Studier tillägnade. Upsala: F. R. Kjellman, 1906, pp. 21–38 (1 pl., figs. in text.)

† Kew Bulletin, 1906, pp. 366–73.

‡ Bull. Imp. Inst. iv. (1906) pp. 125–49.

§ Annals of Bot., xxi. (1907) pp. 61 70 (1 pl.).

and will even produce an abundant supply of both antheridia and oogonia. Apparently a very small number of spores are capable of germination, producing a pro-embryo of characteristic growth. The pro-embryos produced from the oospores resemble those produced from the underground nodes of the plant. In many cases the pro-embryo differs from that of other Characeæ by the interposition of an extra oblique node, from which rhizoids are produced. In the case of the pro-embryos produced from the rhizoid-nodes bearing tubercles, about 30 p.c. showed this interposed node. For the most part reproduction takes place by means of pro-embryos, which are formed on the rhizoid-nodes and make use of the starch stored up in the tubercles. Branch embryos are rare. Sometimes pro-embryos arise from rhizoid-nodes bearing no tubercles, or from the rhizoid-node of another pro-embryo. The tubercles either originate as such, or are formed by the transformation of rhizoids. The terminal rhizoid of a tubercle may again become transformed into a tubercle containing starch, thus forming a series of two or more tubercles. The pro-embryos arise at the basal side of the tubercle. Generally, several pro-embryos arise from a node bearing tubercles. The nuclei of the tubercles are fragmented, as in the case of the internodal cells.

Swedish Species of Chantransia.*—H. Kylin describes in detail four species of *Chantransia* which occur in Sweden, three of which are new. These are *C. pectinata*, which in habit resembles *C. efflorescens*, differing from it in having thicker branches and much shorter cells; *C. hallandica*; and *C. parvula*. *C. hallandica* is found growing on species of *Ceramium*, *Polysiphonia* and *Callithamnion* at a depth of 10–20 metres. Figures are given of all the species described.

Corsican Moss.†—F. Jadin and J. B. Garçain have examined this commodity, which is used as a vermifuge, and finds that it is a mixture of algæ, of which the predominating species is *Alsidium Helminthochorton*. The material examined was obtained from druggists, and was compared by the authors with specimens collected in the Gulf of Ajaccio. The other algæ found in Corsican moss were: *Jania rubens*; *Gelidium corneum*; *Padina pavonia*; and *Acetabularia mediterranea*.

Polysiphonia violacea.‡—S. Yamanouchi publishes the complete account of his studies on this species, of which he had previously given a short account in the Botanical Gazette. In the present paper he gives first the results of his studies of the mitosis in germinating tetraspores and carpospores and in the vegetative cells of mature plants; then comes an account of spermatogenesis, formation of procarp, fertilisation, and development of the cystocarp; tetraspore formation is then considered, followed by a description of certain abnormalities; finally, there is a discussion of the cytological phenomena and alternation of generations. This last topic has been given considerable attention, for the chief results of this investigation have been the establishment of an antithetic

* Botaniska Studier tillägnade. Upsala: F. R. Kjellman, 1906, pp. 113-26.
† Bull. Pharmacie du Sud-Est., xi. (1906) 4 pp.
‡ Bot. Gazette, xlii. (1906) pp. 401–49 (10 pls.).

alternation of generations in *Polysiphonia*, with the period of chromosome reduction at the time of tetraspore formation.

The author finds that the carpospore on germination shows 40 chromosomes, and the tetraspore 20, and, since in the vegetative mitoses of the tetrasporic and sexual plant the same numbers appear respectively, he infers that tetrasporic plants come from carpospores and sexual plants come from tetraspores. The nuclei of the gametes (sperm and carpogonium) contain each 20 chromosomes. The fusion nucleus in the fertilised carpogonium as a result has 40 chromosomes, and gives rise to a series of nuclei in the central cell. Some of these enter the carpospores, which are consequently a part of the sporophytic phase to be continued in the tetrasporic plant. The gametophyte nuclei in the central cell of the cystocarp with 20 chromosomes break down. Tetraspore-formation terminates the sporophytic phase with typical reduction phenomena, so that the tetraspores are prepared to develop the gametophyte generation. The cystocarp is included as an early part of the sporophytic phase.

New Coralline Algæ.*—M. Foslie and M. A. Howe describe two new species of Corallines from the Island of Culebra, lying between Porto Rico proper and St. Thomas. They are *Goniolithon acropetum* and *Lithophyllum antillarum*. The former is, probably, most nearly allied to *G. frutescens* Fosl. f. *flabelliformis* of the South Pacific, but is coarser, more anastomosed, often much more widely dilated, and more conspicuously decutescent. It also differs in its conceptacles and sporangia. *L. antillarum* is a reef-builder, and bears some resemblance to coarse forms of *L. africanum* Fosl. and *L. craspedium* Fosl., another South Pacific species.

Normal and Abnormal Germination in Fucus.†—E. Küster discusses the result of some experiments which he undertook with a view to testing the statements of Rosenvinge concerning the germination of fertilised oogonia of *Fucus*. That author maintained that the direction of the first cross-wall and the development of polarity in the germinating egg were influenced by external factors. Küster examined *Fucus serratus* and *F. platycarpus*, and his results confirm in general those of Rosenvinge. He finds that in a typical course of germination only one rhizoid-papilla arises on the egg, but there are exceptions, and these he describes and figures, showing also the manner in which he was able to bring this about. He concludes by stating that the normal course of development is hindered or prevented by osmotic disturbances; and he considers it possible that certain osmotic conditions in the egg determine the place of formation of the rhizoid—a theory which is in keeping with the results of experiments on *Fucus*, *Pelvetia*, and *Cystoseira*.

Renfrewia, a New Genus.‡—R. F. Griggs describes a new genus of Laminariaceæ, distinguished from *Laminaria* by having a simple discoid holdfast without haptera. The type species of the genus is *R. parvula*, which, from its small size and evident simplicity of structure, may be

* Bull. Torrey Bot. Club, xxxiii. (1906) pp. 577–80 (4 pls., figs. in text).
† Ber. Deutsch. Bot. Gesell., xxiv. (1906) pp. 522–8.
‡ Postelsia, Year Book Minnesota Station, 1906, pp. 247–74 (figs. in text).

regarded as a primitive form of kelp. A variety is described, var. *perlonga*, which is often more than a metre long, while the type appears not to exceed 50 cm. in length by 25–90 mm. wide. Cryptostomata are absent even on young plants, as are also mucilage ducts. The sorus is mostly irregular in shape, and sometimes it takes the form of five (or less) fructiferous stripes. Both sides of the lamina are fertile. It differs from *Phyllaria* in having no cryptostomata, and from *Cymathere* in having a flat, not a folded, lamina. The author transfers to this genus, *Laminaria solidungula* J. Ag. and *L. yezzoensis* Miyabé.

Colpomenia sinuosa.*—C. Sauvageau addresses the Scientific Society of Arcachon on the subject of the possible invasion by this alga of the oyster beds in the Basin of Arcachon. He speaks of the general conditions necessary to the growth and spread of the species, and the danger of introducing it by spores, or otherwise, from those places where it has already proved so disastrous to the oyster culture. He considers that the optimistic view of Fabre-Domergue as to the eradication of the plant is not justified. Other algæ which are prejudicial to the oyster beds are treated of, and the suggestion is made of introducing herbivorous Gastropods at Arcachon, as has been done at Sables-d'Olonne, in order to keep down certain richly-growing species of algæ.

Cladostephus verticillatus.†—C. Sauvageau has investigated minutely the history and identity of *Cladostephus verticillatus*. He comes to the conclusion that the real author of the species is Lyngbye, who designated by this name a plant which was a variety of the type at a time when the limits of the species were not sufficiently defined. The elder Hooker at a later date gave this name to the type, while C. Agardh, who created the name originally, used it to denote an alga belonging to a totally different group. The present author therefore considers that priority should be accorded to Lyngbye and the species known as *C. verticillatus* Lyngbye. He gives the full synonymy of *C. spongiosus* and *C. verticillatus*, as well as that of his own variety, *patentissima* of *C. verticillatus*. He adds a list of names which must be struck out from the synonymy of either species.

Formation of Gametes in Bryopsis.‡—H. Freund gives the result of some experiments on the conditions which lead to the formation of gametes in *Bryopsis plumula* and *B. muscosa*. He quotes Oltmann's description of the different forms of male and female gametes, as well as the process of copulation, and then describes the treatment to which he subjected the plants, with the corresponding results. Finally, he adds a few details on the morphology of *Bryopsis*.

Botryodictyon and Botryococcus.§—G. W. F. Carlson has made a careful comparison of *Botryodictyon elegans* Lemmermann and *Botryococcus Braunii* Kütz, and finds that they are identical. He believes that *B. elegans* is only a *Botryococcus* colony, and he gives his reasons for this conviction. The position of *Botryococcus* among the Chlorophyceæ,

* Soc. Sci. Arcachon, ix. (1906) pp. 35–49. † Tom. cit., p. 30.
‡ Beih. Bot. Centralbl., xxi. (1907) pp. 55–9.
§ Botaniska Studier tillägnade. Upsala: F. R. Kjellman, 1906, pp. 141–6 (1 pl.).

and the views of various authors on the subject, are discussed. Carlson himself considers that its allies are *Apiocystis*, *Tetraspora*, and *Stapfia*, which possess the same "pseudo-cilia" as *Botryococcus*, though in the last-named genus they are considerably shorter than in the other genera. *Botryococcus* is therefore regarded by the author as the most primitive and *Apiocystis* as the most highly developed of this group.

Rhizoids of Mougeotia.*—A. A. Pascher gives an account of previous work on the formation of the rhizoid-like outgrowths which occur on *Mougeotia*, and describes the result of his own investigations on sterile plants collected by him in Southern Bohemia. These appeared every year in an artificial basin of water at the end of March and lasted for a month, after which their place was taken by a species of *Stigeoclonium*. The *Mougeotia* filaments developed a rich growth of rhizoids, and the author describes in detail their manner of origin as well as that of the chromatophores which enter them from the main filament. He points out that after the earliest stages the name "rhizoid" is incorrect for these outgrowths, which with their chromatophores and cell-division are really branches. He merely follows former writers in using the term. He holds that they are, notwithstanding their frequent occurrence, an abnormal growth and caused by outside influences. All attempts failed to cultivate the alga under similarly abnormal conditions to those in which the material examined was growing.

Dunaliella.†—E. C. Teodoresco completes his morphological and biological observations on this genus, and gives his reasons for maintaining two distinct species, *D. salina* already known, and *D. viridis* a new species. He finds that the former has zoospores with hæmatochrome and no stigma, which produce red gametes reproducing the same type of zoospore, while the latter, *D. salina*, is always green and always possesses a red stigma. The exceptional conditions under which these species can live is described, under the headings of dryness, temperature, darkness, light, and concentration of water. The various experiments of the author are described.

Fossil Diatoms in New Jersey.‡—A. M. Edwards publishes an account of fossil Diatoms discovered by him in the north-eastern part of New Jersey in 1890. He describes the geological position of the deposit, and makes critical remarks on the species found there. These point to the existence of a former lake, which was discovered independently by the author, but had been already recognised by G. H. Cooke, and called Lake Passaic.

Navicula ostrearia.§—C. Sauvageau makes some interesting remarks on this Diatom, which has been studied by several authors and has lately been recorded from the Mediterranean by Molisch. The author deals with past work on the subject and with the history of species. The Diatom is not confined to the shells of oysters (where, of course, it

* Flora, xcvii. (1907) pp. 107–15.
† Rev. Gén. Bot., xviii. (1906) pp. 409–27.
‡ Nuov. Notar., xviii. (1907) pp. 39–48.
§ Soc. Sci. Arcachon, ix. (1906) pp. 49–59.

occurs abundantly, giving them a blue colour), but was found by the present author covering specimens of *Liebmannia Leveillii*. He has, however, never found it on other species of Phæophyceæ. *N. ostrearia* is said to require a certain admixture of fresh-water with the sea-water, but when growing on *Liebmannia* it was in sea-water pure and simple. As regards the seat of the blue colouring-matter, the author finds that it is in the protoplasm, thus confirming the assertion of Ray Lankester; on the other hand, he combats the statements of that zoologist with regard to the extreme difficulty of dissolving the colouring matter. Sauvageau finds that a simple drop of fresh-water dissolves it out at once.

Yorkshire Diatoms.*—R. H. Philip gives a list of 19 Diatoms collected by M. H. Stiles in the Bog Pond at Askern in last July, and adds a list of 27 additional species collected by himself in Askern Pool, and some of the adjacent pools and ditches.

Growth of Globular Algæ.†—T. Hedlund has made a study of the rate of increase in growth in algæ of a globular form, as this form lends itself more easily to such a study. Several species were investigated which are found living symbiotically in *Cladonia*, *Physcia*, and other lichens. The author finds that an alga grows more quickly when free than when in touch with others. It grows more slowly when its protoplasm is undergoing division; as also when division is complete, but the protoplasts are not divided by any cell-walls. Growth begins to slacken one or several days before division takes place; and the more numerous the plasma bodies to be formed, the longer time beforehand does the diminution in growth begin. The individuals which arise from the swarmers grow more slowly at the beginning when they are still very small, than later. The algæ, which are removed from a heteromerous lichen thallus do not all grow at the same rate, even when they are from the same part of the thallus. The author describes his experiments, and tabulates many of his results.

A New Genus of Chrysomonadineæ.‡—R. Lauterborn describes minutely a new genus *Palatinella* of this group, to which of late years so many additions have been made. *Palatinella cyrtophora*, the single species of the genus, grows affixed to a filament of *Bulbochæte*; it is related on the one hand to *Pedinella* and on the other to *Chrysamœba*.

Calcareous Deposit in Lough Carra.§—R. Lloyd Praeger quotes in a short note the answer sent by W. West to questions by the author, on a possible connection between algæ and the calcareous deposit that covers the bottom of Lough Carra. West finds that much of the matrix of the calcareous incrustation is formed by *Dasyglæa amorpha* Berk., and he records also *Stigonema mamillosum* Ag., *Phormidium* (?) *tenue*, and others. He suggests an explanation for the curious fact that, while deposition of lime is going on in Lough Carra,

* Naturalist, No. 599, 1906, p. 428.
† Botaniska Studier tillägnade. Upsala: F. R. Kjellman, 1906, pp. 35-54 (with tables).
‡ Zool. Anzeig., xxx. (1906) pp. 423-8.
§ Irish Naturalist, xv. (1906) pp. 232-3.

the limestone is being dissolved, apparently with some rapidity, in the adjoining and, on the whole, similarly situated loughs of Corrib, Mask, and Conn.

Phytoplankton from Madrid.*—A. Forti records the first collection of fresh-water phytoplankton from Spain, made by himself in the "Estanque grande" in the park of Buen Retiro, Madrid. It is a shallow rectangular lake, measuring 300 by 100 metres, and there is an absence of Phanerogamic or Bryophytic vegetation round its shores. It is therefore not surprising that the occurrence of Chlorophyceæ in the lake is insignificant. On the other hand, the Cyanophyceæ, and more especially the Chroococcaceæ, are very richly developed—so much so as to give the water the appearance of a Flos Aquæ. They represent more than half the mass of the entire plankton. The most common species is *Clathrocystis æruginosa* Henfr., while limnetic Diatoms, Peridinieæ, and Oscillatoriæ, are either sporadic or entirely wanting. The fauna is copious. These results are gathered from two surface samples taken by dragging an Amberg net behind a boat going at moderate speed, and one vertical sample taken in the deepest part of the lake (4–5 m.) on August 23, 1901, in brilliant weather. A list of 21 species, including a few zooplankton, is given, with notes appended to each.

Plankton of Lakes in Russian Lapland.†—K. M. Levander gives an account of the plankton of six lakes in the Kola peninsula, and his work may be summarised as follows. The samples are very rich in plankton species. It is characteristic that so many shore forms occur in the plankton. There are many species of Desmids. *Anabæna flos aquæ* and *Cœlosphærium Naegelianum* are the most common Myxophyceæ. Among the Protococcaceæ, *Botryococcus Braunii* is the most predominant form. Among the Diatoms, *Tabellaria fenestrata* and *T. flocculosa* occur in large quantities; also *Asterionella* and *Fragilaria crotonensis* are common, while the Melosiræ are rare. Myxophyceæ, 9 Protococcaceæ, 2 Zygnemaceæ, 30 Desmidiaceæ, 11 Diatomaceæ, 8 Flagellatæ, and 3 Peridineæ, have been found. The paper is illustrated.

Scottish Fresh-water Plankton.‡—W. and G. S. West continue their studies on the fresh-water plankton of the Scottish lochs. Material was collected from more than twenty of the lochs in Perth, Inverness, Ross, and the Outer Hebrides. A detailed account is given of the plankton investigated, followed by a list of species in tabular form, including algæ from Loch Tay, Perthshire, and from Loch Lazadale, Harris, previously recorded by the authors. Collections are also included from lochs in Sutherland and Inverness, made by J. Murray. The Peridineæ were worked out by Lemmermann of Bremen, who describes a new species of *Peridinium*. The authors describe three new species and many new varieties, most of them having been found in Loch Fadaghoda, Lewis. Certain rare Desmids are here recorded for the first

* Atti Soc. Nat. Modena, viii. (1906) 9 pp.

† Festschr. f. Palmen, ii. (Helsingfors, 1905) 49 pp., 3 pls.

‡ Trans. Roy. Soc. Edinburgh, xli. (1906) pp. 477–518 (7 pls.).

time from the British Isles; a new genus of Protococcoideæ is described, and other interesting species are mentioned as occurring in the collections. General remarks are made on Scottish phytoplankton, and a summary of our present knowledge of the phytoplankton of the inland waters of the West of Scotland completes the paper. Five plates of microphotographs and two of ordinary figures add largely to the value of this paper.

BORZI, A.—**Conspectus generum Stigonemataceearum.**
[Gives a conspectus of three tribes, which include 15 genera, seven of which are new.] *Nuov. Not.*, xviii. (1907) pp. 37–8.

BROCH, HJ.—**Bemerkungen über den Formenkreis von Peridinium depressum s. lat.**
[Remarks on the form-group of *P. depressum*.]
Nyt. Mag. Naturvid., xliv. (1906) pp. 151–7.

HUITFELDT-KAAS, H.—**Planktonundersøgelser i Norske Vande.** (Plankton investigations in the Norwegian lakes.)
(Christiana Nationaltrykkeriet 1906), 199 pp., 3 pls., 9 tables.

LEVANDER, K. M.—**Ueber das Winterplankton in zwei Binnenseen Süd Finlands.** (On the winter plankton of two inland lakes in South Finland.)
Acta Soc. Fauna et Flora fennica, 1905, 14 pp.

MAILLEFER, A.—**Chamæsiphon sphagnicola.**
[Description of a new species, *C. confervicola*, found in the porous cells of leaves of *Sphagnum quinquefarium* at Pont-de-Nant, Vaud.]
Bull. Herb. Boissier, vii. (1907) pp. 44–5 (figs.).

MARCOVEI, G., ET SCRIBAN, J.—**Contribution à l'Étude de la Flore des lacs d'eau douce de la Dobrogea.** (Contribution to a study of the flora of the fresh-water lakes in Dobrogea.) *Ann. Sci. Univ. Jassy*, iii. (1906) pp. 239–43.

MAZZA, A.—**Saggio di Algologia Oceanica** [cont.]. (Essay on Oceanic algology.)
[Describes species of the following genera:—*Callophyllis*, *Callymenia*, *Glaphrymenia*, *Meredithia*, *Callocolax*, *Cystoclonium*, *Catenella*, *Agardhiella*, *Turnerella*, *Flahaultia*, *Meristotheca*, *Euthora*, *Rhodophyllis*, *Acanthococcus*, and genera of Solieriesæ.]
Nuov. Not., xviii. (1907) p. 1–36.

NAMIKAWA, S.—**Fresh-water Algæ as an Article of Human Food.**
Bull. Coll. Agr. Tokyo, vii. (1906) p. 123.

OSTERHOUT, W. J. V.—**Resistance of certain Marine Algæ to Changes in Osmotic Pressure and Temperature. Role of Osmotic Pressure in Marine Plants. Importance of physiologically balanced Solutions for Plants. Antitoxic action of Potassium and Magnesium.** *Univ. California Publications* (*Bot.*), 1906.

QUELLE, F.—**Bemerkungen über den Bau einiger Süsswasser-diatomeen.**
[Remarks on the structure of some fresh-water Diatoms.)
Mitth. thüring. bot. Ver., 1906, p. 111.

SCHÖNFELDT, H. VON—**Diatomaceæ Germaniæ. Die deutschen Diatomeen des Süss- und Brakwassers. Nebst Einführung in den Bau und das Leben der Diatomeenzelle und Anleitung, die Diatomeen zu sammeln und zu präpariren.** (German fresh and brackish-water Diatoms, with an introduction into the structure and life of the Diatom cell, and instructions how to collect and prepare Diatoms.)
Berlin, 1906, 456 figs. on 19 pls.

SCHORLER, B., & J. THALLWITZ—**Pflanzen- und Tier-welt der Moritzburger Grossteiches bei Dresden.** (Flora and fauna of the great Moritzburg pond, near Dresden.) *Ann. biol. lacustre*, i. (1906) p. 118.

SPINELLI, V.—**Le alghe marine della Sicilia orientale.** (Marine algæ of eastern Sicily.) *Atti Acad. Gioenia Catania*, xviii. (1905) 55 pp.

WOLTERECK, R.—**Mittheilungen aus der Biologischen Station in Lunz.** (Communications from the biological station at Lunz.)

[This paper gives many notes on the characteristics of the surroundings of the three lakes of Lunz, with a preliminary report of the fauna and flora of those lakes, and an account of the new biological station of Lunz.]

Biol. Centralbl., xxvi. (1906) pp. 463–80 (figs.).

ZIMMERMANN, C.—**Catalogue das Diatomaceas portuguesas.** (Catalogue of Portuguese Diatoms.) *Broteria*, v. 4 (1906).

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

New Species of Saprolegniaceæ.*—C. D. Harz found on the back of a living carp a vigorous growth of a fungus which he diagnosed as *Achyla Hoferi*, sp. n. The filaments bore oogonia and numerous large oospores, but no antheridia. The fungus penetrated deep into the body of the carp. The author thinks that it probably does this by means of an enzyme which breaks up the tissues.

Germination of Synchytrium Spores.†—Walther Rytz publishes a preliminary note on this subject, having been successful in his laboratory cultures of the spores of the species *S. alpinum* and *S. cupulatum*, and of *S. saxifragæ* sp. n.

Identity of Mucor Mucedo.‡—Guy West Wilson has been tracing the history of *Mucor Mucedo* through various authors back to the "Species Plantarum" of Linnæus published in 1754. The genus had been founded by Micheli in 1739 with the species *Mucor vulgaris*, now known as *Rhizopus nigricans*. The plant now accepted as *Mucor Mucedo* was originally described by Tode as *Hydrophora stercorea*, by Link as *Mucor stercoreus*, by Persoon as *Mucor caninus*, and finally by Fresenius as *Mucor Mucedo*.

Relation between some Ascomycetes and their Substratum.§—Carl Kratz has confined his study to a series of Pyrenomycetes that are mainly saprophytic on herbaceous stems or leaves. He examines the nature of the mycelium, the method of infection, and the way in which the fungus adapts itself to the structure of the host. He selects first four species of *Leptosphæria* that grow on the lower parts of the dead stems of *Urtica*. He finds in the stems of *Urtica* and allied plants a closed ring of bast fibres through which the mycelium cannot penetrate, and he concludes that infection must have taken place before the formation of this ring, and that these fungi which are seated on the wood were primarily parasitic on the young nettles. Bast fibres and stone cells are impenetrable and unserviceable to mycelium; all the other tissue elements can be pierced and destroyed. Wood-cells are destroyed by means of an enzyme: when that is not forthcoming the mycelium cannot penetrate the wood, but forms a zone of tissue round the stem.

* Allg. Fisch. Zeit., 1906, pp. 365–8. See also Bot. Centralbl., civ. (1906) p. 16.
† Centralbl. Bakt., xvi. (1906) pp. 511–12.
‡ Bull. Torrey Bot. Club., xxxiii. (1906) pp. 557–60.
§ Hedwigia, xlvi. (1906) pp. 1–24 (8 figs.).

By means of the medullary rays, the fungus is able to penetrate deep into the wood; it grows luxuriantly in these rays, and also in the vessels; in the woody tissue it is intracellular, but in ~~the softer~~ tissues of the leaf it is confined to the intercellular spaces. It is impossible to diagnose the fungus from the appearance of the mycelium; the nature of the host-plant can, however, be deduced, as, for instance, when the host contains oil, as in the Umbelliferæ, where there are oil-globules present in the mycelium. He notes specially the differences between the mycelium of *Leptosphæria Rusci* on *Ruscus aculeatus* and on *R. Hypoglossum*. In the former it is of narrow lumen, in the latter broad and full of oil-globules. The size and form of the ripe perithecia are also conditioned by the position in which they grow and by the contents of the surrounding host-tissue.

Franz Duysen * has made a similar study of some forms of Discomycetes in the several groups Pezizineæ, Phacidiineæ and Hysterineæ. The Discomycetes possess a branched, septate mycelium which forms at times a considerable growth of loose hyphæ and of plectenchyma. There is no sharp distinction between vegetative and fruit-forming mycelium. Duysen has examined and describes in full detail the habit and growth of fifteen species, and sums up his results at the end of the paper. These coincide largely with those arrived at by the previous writer in his study of the Pyrenomycetes. The mycelium encounters the same series of tissues and grows under the same conditions as already described. As before, the medullary rays and the vessels are attacked most readily. Somewhat more attention has been given to the penetration of the wood-cells. The hyphæ enter and leave these cells through the pits, and very often there is a swelling of the hypha as it approaches the pit, and again after it passes. The passage through the pit is narrower than the hypha, so there is a massing of plasma contents both before and after the constriction. The same substratum offers similar difficulties or advantages to all fungi growing on it, so the different fungi attack it in the same manner, and the direction followed by the mycelium of any fungus is due entirely to the physical conditions of the tissues.

Sclerotinia Coryli.†—H. C. Schellenberg records a case of this fungus occurring in the axis of the male flowers of the hazel. The diseased catkins were in the winter condition, and the pollen-sacs were undeveloped, so infection must have taken place in the autumn about the time when the catkins were first formed. Those attacked dry up; they remain on the branches till spring, then fall to the ground, and apothecia are not formed until the following spring. The first sclerotia are formed in the cortical parenchyma, stray hyphæ pass out to the epidermis, while others push inwards through the medullary rays to the pith, where another sclerotium is built up. The sclerotia do not possess an outer sheath, that layer being supplied by the destroyed tissues of the host-plant. The author did not get any *Monilia* growth, but he is convinced that the *Monilia* that occurs in the ovules belongs to the same fungus as the sclerotium of the male catkins. The biology of the

* Hedwigia, xlvi. (1906) pp. 25–56 (7 figs.).
† Ber. Deutsch Bot. Gesell., xxiv. (1906) pp. 505–11 (1 pl.).

plant confirms this view, as the ascospores are produced and scattered just when the young fruit is at the stage of infection. The production of *Monilia* spores goes on until July or the beginning of August, when next year's male catkins begin to form. Schellenberg names the fungus *Sclerotinia Coryli*. He has found the disease rather wide-spread in Switzerland.

New Parasite on Cherry-leaves.* — N. Speschnew describes a fungus which he determines as *Ovulariopsis persicina* sp. n. The conidial form of the fungus only has been met with. The hyphæ which grow on the upper surface of the leaf penetrate the epidermis, and can be traced in the intercellular spaces to the lower epidermis.

Yeast Plant. — Fred Mutchler † finds that the cytoplasm of the yeast-cell is more or less reticulated, vacuolated, or areolated; the nucleus occupies the centre of the cell, and is comparatively very large, with a distinct nuclear membrane; in close association with the nucleus are 6–10 small but definite granules. No evidence of karyokinesis was observed; the division is believed to be direct.

The effect of various substances—metals, formalin, hydrogen peroxide, acids, alcohol, and anæsthetics—was tested on the yeast, and as it remained constant, the conclusion drawn is that *Saccharomyces Cerevisiæ* is a stable species; that variation in form is due to the inherent nature of the cell; that variation in size and rate of growth is produced by changes in the culture conditions; and that anæsthetics do not permanently destroy the growth or reproduction of this species.

Th. Bokorny ‡ has made a study of the dividing line between life and fermenting power in the yeast-cell. When treated with poisons it has been found that the enzymes are affected in the same way as the protoplasm, but that the effect is weaker. The author set himself the task to find the exact quantity of poison that would kill the protoplasm without injuring the enzyme. Those used were sulphuric acid, formaldehyde, and sublimate. He was able to estimate in each case the exact amount of the poison for a given quantity of yeast that left the enzyme still capable of fermentative action while destroying the yeast-cell.

Polymorphism of Colletotrichum Janczewskii.§—B. Namyslowski found this fungus parasitic on the stalks, occasionally on the leaves, of *Poa trivialis*, where it forms small pustules. The spores, which are fusiform and somewhat bent, were grown in artificial cultures, where they produced a septate mycelium with chlamydospores at the tips of the branches. From some of the hyphæ were formed conidiophores on which were borne the same conidia as in the original pustules. An attempt to reinfect *Poa trivialis* was unsuccessful.

* Monit. Jard. Bot. Tiflis, livr. 3 (1906) pp. 1–5 (Russian). See also Bot. Centralbl., cii. (1906) p. 612.

† Journ. Medical Research, Boston, xvi. (1905). See also New Phytol., v. (1906) p. 250.

‡ Arch. Ges. Phys., cxiv. heft 11-12 (1906) pp. 535–44. See also Bot. Centralbl., civ. (1907) p. 7.

§ Bull. Acad. Sci. Cracovie, Classe Sci. Math. Nat., 1906, pp. 254–7 (1 pl.). See also Bot. Centralbl., civ. (1907) pp. 93–4.

Uredineæ.*—P. Magnus records the infection of an introduced plant by a Uredine common in the district, into which it had been imported. *Chrysomyxa Rhododendri* produces the uredo- and teleutospores on species of Rhododendron; the *Æcidium* grows on the needles of *Picea excelsa*. *Picea pungens* var. *glauca* was imported from the Rocky Mountains and planted in a garden along with the Rhododendrons infected by the *Chrysomyxa*. In due time the *Æcidia* appeared on the leaves of the American plant. He notes other cases in which a similar change of host has taken place.

Paul Cruchet † concludes the account of his experiments with *Puccinia Menthæ* on various host-species. He finds eight biological forms within the parasite growing on *Mentha* and *Satureya*. A careful morphological examination showed that there was no marked difference between any of the forms. The *Æcidia* are exactly alike in every case observed. The uredospores and teleutospores were also compared, and no real distinction was noted. He records the results of 38 different experiments.

Frank D. Kern ‡ gives an account of the rusts collected by W. A. Kellerman during a journey to Guatemala. In many instances, he tells us, new hosts have been added and the geographical distribution has often been extended. Several new species are included in the list, which comprises 40 plants.

Indian wheat rusts are examined and discussed by E. J. Butler and J. M. Hayman.§ They are *Puccinia graminis*, *P. glumarum* and *P. triticina*. The peculiar climatic conditions of India are taken into account, and the absence of *Æcidium* forms, which raises the question of the continued propagation of the parasite. Methods for checking rust attacks are also described.

New Genera of Uredinales.‖—J. C. Arthur establishes four new genera in this group: *Polioma* type species *Puccinia nivea*, with only spermogonia and teleutospores; *Spirechina*, which possesses uredo- and teleutospores; *Prospodium*, with spermogonia, uredo- and teleutospores, the sori of both surrounded by paraphyses; and *Nephlyctis*, with spermogonia and teleutospores only, without peridium or paraphyses. He has taken into account the morphological characters, life-cycle and family of the hosts in making these new genera.

Monograph of the Genus Ravenelia.¶—P. Dietel traces the history of this genus of the Uredineæ from the record of the first species by Schwenitz in 1822 as *Sphæria epiphylla* down to the present day. He then studies the morphology of the different stages in the life-history: of the mycelium, which penetrates the leaf or stem tissue, and in one instance at least is perennial; the *Æcidia*, which occur but seldom; the uredospores, which vary much in form, and the peculiar and characteristic teleutospores. These latter are composed of three parts; a stalk,

* Ber. Deutsch. Bot. Gesell., xxiv. (1906) pp. 474–6.
† Centralbl. Bakt., xvii. (1906) pp. 395–411.
‡ Journ. Mycol., xiii. (1907) pp. 18–26.
§ Mem. Dept. Agric. India, Bot., i. No. 2 (1906) 52 pp. (5 pls.).
‖ Journ. Mycol., xiii. (1907) pp. 28–32.
¶ Beih. Bot. Centralbl., xx. (1906) pp. 343–413 (2 pls.).

cysts, and spores. The stalk consists of several hyphæ united throughout their length. The cysts are sterile cells which become quickly turgescent in the presence of water; they are situated at the tip of the stalk, and are either elongate, ovate, or globose. Possibly the gelatinous contents of the cysts help to attach the teleutospores to the plants on which they alight. The spores are formed in a head of one-celled bodies, which are borne above the cysts and equal or exceed them in number. A membrane in many cases studded with spines or warts covers the whole head. Dietel divides the species into groups, according to the form of the cysts and the number of the spores. Two of the species grow on Euphorbiaceæ, the others—78 recorded up to the present time—grow on Leguminosæ. They are only to be found in the warmer parts of the world, both east and west. Those species only that grow on *Mimosæ* pass through the different life-stages of the Uredineæ. Some *Æcidia* have been found on *Acaciæ* that probably belong to *Ravenelia*, but the teleutospores have not been found.

The author gives full diagnoses of the species, and various notes that should prove instructive.

American Species of Ravenelia.*—W. H. Long records and describes two new species of *Ravenelia* from Florida and Jamaica, with emendations and remarks on several Mexican and Texan species already reported. The author also gives notes on the characters that are of service in determining the species; chief among these are the position of the sori, the number and position of the germ-pores, and the position and number of the cysts. He recommends mounting herbarium specimens for microscopic examination in equal parts of alcohol and glycerin.

Notes on Lepiota.†—A. P. Morgan concludes his account of this genus of Agarics, in all 90 species for North America. He subdivides these into 11 groups, and he has added descriptive synopses of these. H. C. Beardslee travelled with C. G. Lloyd in Sweden, and he takes note of the *Lepiotas* they collected, and compares them with the American species. *L. naucina* was very like the American *L. naucenoides*, which differs from the European species in having elliptical apiculate spores. The travellers examined *L. naucina*, and found that it also had elliptical spores, and they conclude that the species are probably identical.

A New Hymenomycete: the so-called Isaria fuciformis.‡—D. McAlpine has thoroughly investigated the structure and fructification of this fungus, and finds that it is a true Hymenomycete, producing its basidia, sterigmata, and spores on the basal effused layer, and occasionally on the outstanding tufts. It is a parasite on grasses, and has done considerable damage in Australia, and to some extent in this country. McAlpine notes that it occurs usually where the grass is poor and unable to withstand attack. It is chiefly found on rye-grass, but also occasionally on other grasses. It may also spread to

* Journ. Mycol., xii. (1906) pp. 233–6.
† Op. cit., xiii. (1907) pp. 1–18.
‡ Ann. Mycol. iv. (1906) pp. 541–51 (2 pls.).

clovers, thistles, etc. McAlpine gives a description of the fungus, which he places in the genus *Hypochnus*.

H. and P. Sydow * add a note to the above paper, to the effect that the genus *Hypochnus* is not a good genus, and that this fungus would fall into the genus *Epithele*, and so it is re-named *Epithele fuciformis*.

Diseases of Plants.—J. B. Dandeno † describes a disease of greenhouse Lettuce due to the fungus *Didymaria perforans*, previously classified as *Marsonia perforans*.

Georg Schikorra ‡ has investigated a disease causing the destruction of Leguminosæ. It is caused by a species of *Fusarium*, that lives as a saprophyte on any remains of the plants, or even in the soil. It enters the living plant by a wound, and quickly destroys the cellulose. Warm moist weather is especially favourable to the spread of the fungus.

Georges Delacroix § describes a disease of the poplar (*Populus canadensis*), which causes the death of branches on the young trees and sometimes destroys the whole tree. This species of poplar is largely cultivated in the south of France, the wood being used to make cases for fruits and vegetables. The disease has been diagnosed to be due to a pycnidial fungus, *Dothichiza populea*, a wound parasite. It forms its fruits under the periderm ; the mycelium is both inter- and intra-cellular, and it is more abundant in the cortex than in the wood, though it is often enough found in the vessels. Delacroix recommends careful burning of the dead branches, spraying the young plants with Bordeaux mixture, and the sterilisation (where possible) of all wounds.

P. Gueguen ‖ examined a number of diseased Marguerites, and found that they were attacked at the "neck" by a fungus that formed minute sclerotia in the tissue of the host, and was visible as little black dots under the epidermis. The sclerotia were cultivated in artificial media, and a conidial form was obtained, a new species of *Acrostalagmus*.

W. A. Murrill ¶ finds that very serious damage is done to living trees of *Castanea dentata* by a fungus, *Diaporthe parasitica* sp. n. It is a wound parasite, and will attack any part of the tree, gradually girdling and killing the branches or stem. The only method of cure is to prune out the diseased parts.

Pathological Fungi.**— M. E. Pinoy has been experimenting recently with fungi that produce mycetomy. From a case where the fungus in question was white, and had been referred to *Streptothrix mycetomi*, he took a portion and inoculated a pigeon. A swelling was induced, and on it a growth of *Sterigmatocystis nidulans*, a dark-coloured form. The author thinks that probably the same fungus is accountable for all the cases recorded.

* Ann. Mycol. iv. (1906) p. 551.
† Mich. Ac. Sc., viii. (1906) p. 45. See also Bot. Centralbl., civ. (1907) p. 16.
‡ Inaug. Diss., Berlin (1906), 34 pp. See also Centralbl. Bakt., xvii. (1906) pp. 577–8.
§ Bull. Soc. Mycol. France, xxii. (1906) pp. 239–52 (1 pl.).
‖ Tom. cit., pp. 254–65 (1 pl.).
¶ Torreya, vi. (1906) pp. 186–9. See also Bot. Centralbl., civ. (1907) p. 122.
** Comptes Rendus, cxliii. (1906) pp. 1175–6.

American Mycology.*—G. F. Atkinson gives the diagnosis of a new species of *Entoloma subcostatum* from Ohio. The fungus is described, and the points of difference from allied plants are noted. W. A. Kellerman † publishes a first set of fungi from Guatemala, ten species. They belong to the Uredineæ and Ustilagineæ. A. P. Morgan ‡ continues his monograph of the American species of *Lepiota*. He deals with those species that have a movable ring; several new species are included in this group. The index to North American mycology, an alphabetical list of articles, authors, subjects, new species and hosts, new names and synonyms, is continued by W. A. Kellerman.§

Flora Italica Cryptogama.‖—Two parts of this large and comprehensive work have come to hand. The first, a bibliography of all Italian writers on fungi, has been compiled by G. B. Traverso. He cites 1474 books and papers, adding a note as to the contents of each. There are, in addition, lists of the mycologists who have had to do with each part of the country.

The second part, also by Traverso,¶ begins the second volume of the general work, and deals with the Pyrenomycetes. In the introduction, the author gives a sketch of the group and an account of their life-history. He also explains the terms used and the arrangement followed. In the main body of the work there are synopses of families, genera, and species, and detailed diagnoses of all the plants, with full synonymy, and any notes that are necessary or helpful. This first instalment deals with the Xylariaceæ, Valsaceæ, and part of the Ceretostomaceæ.

Yorkshire Fungus Foray.**—C. Crossland accounts, as usual, for the fungi collected on the autumn expedition of the Yorkshire Naturalists' Society. A fair number of species were recorded for the two days' foray. An iron-mine was explored, and on the timber used in the mine they found growing *Hypholoma fasciculare*, *Poria vaporaria*, *Merulius lachrymans*, *Sphæria aquila*, and a malformed *Polyporus* not determined.

Notes on British Fungi.††—C. Crossland reports the finding of various rare fungi at Askern on one of the expeditions undertaken by the Yorkshire Naturalists' Society. The *Æcidium* stage of *Uromyces junci* on *Pulicaria dysenterica*, *Ustilago olivacea* on *Carex riparia*, and others, are noted.

Some new records for Co. Antrim are recorded by J. Adams.‡‡ They are *Lepiota procera*, *Phallus impudicus*, *Merulius lachrymans*, and *Hirneola auriculæ-judæ*.

Irish Fungi.—E. L. Maunsell §§ records the finding of a considerable number of *Tuber æstivum*, in groups and of various sizes, slightly protruding over the earth, chiefly under beech-trees. One or two of these

* Journ. Mycol., xii. (1906) pp. 236–7 (1 pl.).
† Tom. cit., pp. 238–41.
‡ Tom. cit., pp. 242–8.
§ Tom. cit., pp. 249–72.
‖ Soc. Bot. Ital. i. fasc. 1. Rocea S. Casciano, 1905, 135 pp.
¶ Op. cit., ii. fasc. 1, Rocea S. Casciano, 1906, 352 pp. (68 figs.).
** Naturalist, No. 599 (1906) pp. 434–6.
†† Tom. cit., p. 374.
‡‡ Irish Naturalist, xv. (1906) p. 280.
§§ Tom. cit., p. 232.

truffles had been found in previous years in the same locality, Co. Limerick.

D. McArdle* chronicles the finding of a *Morel* in Co. Galway, new to Ireland though not to Britain, and determined as *Mitrophora semilibera*. The stalk is about 5 in. high, 1 in. thick at the base, the pileus 1½ in. high, and free for rather more than half its height.

Cases of Poisoning by Fungi.†—The first case is reported by V. Harlay, and was found to be caused by *Pleurotus olearius*. The patients recovered after a few hours' severe illness. The writer adds some notes on the phosphorescence of this fungus. The second case is that of a family who had eaten freely of *Entoloma lividum*. In half an hour or so violent sickness followed. The cases were attended by a doctor, who describes the symptoms. The illness was not fatal.

Alimentary Value of Amanita junquillea.‡—L. Mangin claims for this Agaric a high comestible value, and quotes from friends who have eaten it constantly without any bad effect. He does not deny possible cases of poisoning, but calls attention to the fact that all fungi, if they are too old, or kept too long, may become poisonous; and also that some people are peculiarly sensitive to any poisonous principle there might be in Agarics, while others can eat almost any species with impunity. Even *Amanita muscaria* has been eaten without bad effects.

Chemistry of Amanita muscaria.§—P. Q. Keegan has analysed this plant, and gives the percentages of the various constituents. He specially notes the presence of 15 p.c. of a ptomaine called muscarine, a narcotic or nerve-poison. The scarlet colour of the pileus is not due to carotin or tannin, but to the oxidative action of its tissues on the nuclear matter distributed therein. The scarlet pigment is similar or analogous to that in beetroot.

Zonation in Artificial Cultures of Fungi.‖—George G. Hedgcock grew various fungi on agar plates under bell-jars of different colours, thus subjecting the growing and fruiting fungus to orange, red, blue, green, and white light. Under blue and white light he found that there was a limited spore-production during the day, with a much denser growth at night, indicating that the blue rays inhibit spore production. The alternate growths formed very distinct zones in the cultures.

New Colour Scheme for Fungi.¶—Paul Klincksieck draws attention to the great number of terms uncertainly used to distinguish colours, and cites sixteen terms used for shades of white alone. Instead of names or coloured plates he proposes numbers. The primary colours are placed at the angles of a triangle, a circle drawn round the outside

* Irish Naturalist, xv. (1906) pp. 158–9.
† Bull. Soc. Mycol. France, xxii (1906) pp. 271–4 and 279–80.
‡ Tom. cit., pp. 276–8.
§ Naturalist, Nov. 1906, pp. 397–8.
‖ Seventeenth Ann. Rep. Wiss. Bot. Gard., 1906, p. 115 (2 pls.). See also Bot. Centralbl., cii. (1906) pp. 637–8.
¶ Bull. Soc. Mycol. France, xxii. (1906) pp. 266–70 (1 fig.).

and touching the three, points the gradations of shades indicated by numbers marked on the circle. This scheme is to be applied to the text of L. Rolland's new "Atlas des Champignons."

Chromogenic Fungi.*—George G. Hedgcock has made a study of those fungi which discolour the wood on which they grow. He divides these into three groups: the wood-bluing fungi represented by *Ceratostomella*; wood-browning fungi, such as *Graphium*, *Hormodendron*, etc.; and wood-reddening fungi, represented by *Penicillium* and *Fusarium*. In the case of the first two groups, the blue colour of the wood, as well as the brown, is caused by the hyphæ of the fungus. *Penicillium* secretes a soluble red or yellow pigment, which is absorbed by the wood. *Fusarium* discolours the wood by its hyphæ and by the secretion of a pigment.

Function of Mycorhiza.†—In an account of the growth of some orchids, M. W. Beijerinck includes a description of the mycorhizæ found on their roots. He isolated the mycelium, and grew it on agar plates along with the seed of the orchis, and found that his culture was successful. Without the aid of a fungus the higher plants could not continue to grow. Probably, he thinks, the fungus supplies inorganic as well as albuminoid materials to the higher plant; he proved that it could not, however, assimilate free nitrogen.

ANON.—**Die Kiefernschütte und ihre Bekämpfung.** (Pine disease and its cure.)
[Instructions as to the application of remedies against the fungus *Lophodermium Pinastri*.)
Oesterr. Furst-Jagdzeit., xxiv. (Wien, 1906) No. 32, pp. 266–7.
See also *Bot. Centralbl.*, civ. (1907) p. 89.

BROWN, A. J.—**The Influences regulating the Reproductive Functions of Saccharomyces cerevisiæ.**
[The number of yeast-cells present is a factor in the case, also the presence of alcohol and various gases.]
Journ. Chem. Soc. London, lxxxvii. (1905) pp. 1395–1412.

BUTLER, E. J.—**Fungus Diseases of Sugar-cane in Bengal.**
[An account of various parasites that attack sugar-cane.]
Mem. Dept. Agric. India (*Bot.*), i. No. 3 (1906) 53 pp. (11 pls.).

FISCHER, ED.—**Ueber einige von Herrn Prof. E. Kissling in Sumatra gesammelte Pilze.** (Some of the fungi collected by E. Kissling in Sumatra.)
[A number of interesting species are described; one is new to science, *Pisolithus Kisslingi*.]
Mitt. Nat. Ges. Bern, 1906, 15 pp. (1 pl.).
See also *Ann. Mycol.*, iv. (1906) p. 561.

" " **Verweisung eigentümlichen Pilzbildungen aus dem Simplontunnel.** (An account of peculiar fungus formations from the Simplon tunnel.)
[Abnormal forms of *Agaricini* grew in the steam of a hot spring.] *Tom. cit.*, 1905 (1906), p. xix.
See also *Bot. Centralbl.*, civ. (1907) p. 91.

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* Seventeenth Ann. Rep Wiss. Bot. Jard., 1906, pp. 59-114 (10 pls. and 3 figs.). See also Bot. Centralbl., cii. (1906) p. 637.

† Landbouwkundig Tijdschrift, 1904. See also Bot. Cantralbl., civ. (1907) pp. 89–90.

FLEROFF, A.—**Die Bedingungen der Pigmentbildung bei Pilzen.** (The conditions of pigment-formation in fungi.)
[Experiments were made with *Penicillium purpurogenum*.]
Bull. Jard. Imp. Bot. St. Petersburg, vi. pp. 71–89.
See also *Hedwigia*, xlvi. (1906) Beibl., pp. 8–9.

HEST, J. J. VAN—**Pseudovakuolen in Hefezellen.** (Pseudovacuoles in yeast-cells.
[The writer concludes his study of the subject. He finds that the vacuoles of the cells are in most cases pseudovacuoles.)
Centralbl. Bakt., xvii. (1906) pp. 345–9.

HONE, D. S.—**Some Western Helvellineæ.** (Descriptions of seven different forms of this natural order of Discomycetes.)
Postelsia, 1906, p. 237. See also *Bot. Centralbl.*, civ. (1907) p. 17.

JACOBASCH, E.—**Verpa Brebissonii Gillet, ein Bürger Thuringens.** (*Verpa Brebissioni* Gillet, an inhabitant of Thuringia.)
[A rather rare fungus, now for the first time recorded for Germany.]
Mitt. Thur. Bot. Neue Folge, H xxi. (1906) pp. 51–3.
See also *Bot. Centralbl.*, civ. (1907) p. 71.

KAUFFMAN, C. H.—**The Genus Cortinarius, with Key to the Species.**
[Considerable stress is laid on the size of the spores.]
Journ. Mycol., xiii. (1907) pp. 32–9.

KRAFT, E.—**Ueber das Mutterkorn.** (On Ergot.)
[An account of the substances contained in *Claviceps purpurea*.]
Arch. der Pharm., ccxliv. (1906) pp. 336–59.
See also *Bot. Centralbl.*, civ. (1907) p. 18.

REGENSBURGEN, PAUL—**Vergleichende Untersuchungen an drei obergarigen Arten von Bierhefe.** (Comparative researches on three species of beer yeasts.)
Centralbl. Bakt., xvi. (1906) pp. 438–81 (3 pls., 8 figs.)

REHM, H.—**Zum Studium der Pyrenomyceten Deutschlands, Deutsch-Oesterreichs, und der Schweiz.** (Study of the Pyrenomycetes of Germany, German Austria, and Switzerland.)
[The author deals with the Melogrammaceæ and the Melanconiaceæ.] *Ann. Mycol.*, iv. (1906) pp. 471–82.

" " **Beitrage zur Ascomyceten-Flora der Voralpen und Alpen.** (Contributions to the Ascomycete flora of the Lower Alps and of the Alps.)
[A large number of new species are recorded.]
Oesterr. bot. Zeitschr., lvi. (Wien, 1906) pp. 291–8, 341–8.

" " **Ascomyceten (Exsiccaten-Werk), Fasc. 37, Nos. 1650–75.**
[The larger number are Pyrenomycetes, several of them new species.] Munich, 1906. See also *Bot. Centralbl.*, cii. (1906) p. 639.

RICK—**Fungi Austro-Americani, Fasc. v.–vi., Nos. 81–120.**
[Some new species are issued, also many interesting forms of Basidiomycetes and Ascomycetes.] Fieldkirch, 1906. See also *Bot. Centralbl.*, civ. (1907) pp. 49–50.

RUFFIEUX, L.—**Contribution à l'Étude de la Flore cryptogamique fribourgeoise. Les champignons observés dans le canton de Fribourg.** (Contributions to the study of the cryptogamic flora of Fribourg. The fungi observed in the Canton.)
Mém. Soc. fribourg Sci. Nat. (*Botanique*), Fribourg, 1904, pp. 166–214.
See also *Bot. Centralbl.*, civ. (1907) p. 96.

SACCARDO, P. A.—**Notæ Mycologicæ.**
[A number of new species and others belonging to the Pyrenomycetes and Deuteromycetes are described and figured.]
Ann. Mycol., iv. (1906) pp. 490–4.

SPESCHNEW, N.—**Die Pilzlichen Parasiten des Reises (Oryza sativa).** (The fungal parasites of the Rice Plant.)
[Forty-three species are recorded as parasites on leaves, stalks, flower, and fruit.] *Arb. bot. Gart. Tiflis*, ix. (1906) pp. 23–73 (1 pl.). Russian.
See also *Bot. Centralbl.*, cii. (1906) pp. 611–12.

SYDOW—**Mycotheca Germanica.** **Fasc. x.-xi., Nos. 451-550.**
[A list of the species is given; those that are new are described, and notes are given on some others.] *Ann. Mycol.*, iv. (1906) pp. 483-6.

WEHMER, C.—**Die Bildung freier Oxalsäure durch Aspergillus niger.** (The formation of free oxalic acid by *Aspergillus niger*.)
[The effect of different substances in the solutions is given, and the form, etc., of the crystals of oxalic acid described.]
Ber. Deutsch Bot. Gesell., xxiv. (1906) pp. 381-4 (1 pl.).

Lichens.

(By A. LORRAIN SMITH.)

Biological and Morphological Observations on Lichens.*—W. Zopf found on the maritime rocks of the Island of Kullen on the Swedish coast a lichen very similar to *Ramalina scopulorum*, but differing in its reaction to potash. When treated with this solution the pith of the laciniæ becomes yellow. The prevailing acid in this lichen he names kullensis acid, as contrasted with the scopular acid of *R. scopulorum*. The two lichens which have the same habitat, on rocks exposed to the spray of the sea, can be distinguished by the constant black colour of the base of the stalks of *R. kullensis*.

Chemistry of Rock Lichen (Parmelia saxatilis).†—P. Q. Keegan treated this plant with various reagents, such as boiling benzene, alcohol, lime, etc. He found silica, lime, oxide of iron, etc., and in addition atranorin with a mixture of protocetraric and saxatic acids. The dyeing property of the lichen is mainly due to the former acid. It is thrown out or excreted in the form of minute granules on the exterior of the hyphæ in the cortical portion of the upper surface, and is to be regarded as a waste product of the plant.

ZAHLBRUCKNER, A.—**Neue Flechten.** (New lichens.)
[The author gives lengthy diagnoses of six new species from various parts of the world—Germany, California, Tasmania, etc.
Ann. Mycol., iv. (1906) pp. 486-90.

Mycetozoa.

Development of Myxomycetes.‡—J. C. Constantineau has cultivated a considerable series of Myxomycetes in very varying conditions, and now publishes the observations he has made. For germination the spores require only pure distilled water and oxygen. In some species germination takes place in 30 minutes, in others only after some hours or some days, any introduction of organic substances into the culture solution had no effect on the time required. Results are also given as to germination in other substances. The duration of the zoospore stage varies very much, from 1-2 hours in *Didymium effusum* up to 10 days in *Reticularia*. Osmotic pressure has no appreciable influence on germination, the chemical properties of the medium are more important.

Low temperatures of 2° and 4° restrict but do not hinder germination. The maximum temperature for many species lies about 30°,

* Ber. Deutsch. Bot. Gesell., xxiv. (1906) pp. 574-80 (1 pl.).
† Naturalist, Jan. 1907, pp. 24-5.
‡ Ann. Mycol., iv. (1906) pp. 495-540.

35° or 40°. High temperatures hinder germination in many species. A dry temperature of 80° can be resisted for one hour by the spores, but at 90° they are killed.

The author also gives his notes on the cultivation of plasmodia and the formation of cysts and sporangia. Tables are given of the spore germination in different species, and finally a list of Myxomycetes that occur in the neighbourhood of Halle.

Studies of Myxomycetes.*—E. Jahn publishes a new genus and species of this group which he has named *Listerella paradoxa*. It was found as tiny black specks on the stalk of a lichen (*Cladonia sylvatica*). Jahn thinks that probably the plasmodium lived among the vegetation remains at the base of the lichen and crept up the stalk to form the sessile sporangia. The capillitium threads are most peculiar: they are formed of a succession of somewhat pyriform members forming a continuous chain; the spores are brownish-grey and almost smooth. The affinities of this new form are doubtful; probably it represents a new family of Listerellaceæ.

Schizophyta.

Schizomycetes.

Root-Bacteria of Pulse.†—A. Rodella states that two varieties of root bacteria have been observed—(*a*) *Rhizobium beijerincki*, that grows well on agar, but only with difficulty or not at all on gelatin; (*b*) *R. radicicola*, that grows well on both agar and gelatin. The author has also isolated from tubercles of leguminous plants an anaerobe which he considers to be identical with *Clostridium pasteurianum* of Winogradsky, but which differs from that organism by growing on gelatin, and by its greater facility for growth on glucose-agar. The organism also resembles Omeliansky's cellulose bacillus, but differs from it in staining with iodin, and by its clostridium form. The author thinks that the aerobic growth of anaerobic root bacteria is due to a symbiosis with aerobic organisms.

Action of Bile on Pneumococcus.‡—Nicolle and Adil-Bey have found that cultures of pneumococcus obtained from various sources were dissolved by the addition of rabbit-bile or ox-bile, and also by choleates or biliary salts. The authors consider that this constitutes a diagnostic test for pneumococcus, and serves to separate the organism from other microbes in a mixed culture. They further showed that rabbits vaccinated with choleate solution acquired a certain immunity against pneumococcus. The coccobacillus of fowl cholera, *B. mallei* and *B. pestis*, are much less sensible to the action of bile than the pneumococcus, and *Vibrio choleræ*, *B. typhosus*, *B. coli*, *B. anthracis*, *B. pyocyaneus*, and *B. friedlanderi*, are still more resistant; streptococcus and staphylococcus are entirely refractory.

* Ber. Deutsch. Bot. Gesell., xxiv. (1906) pp. 538–41 (1 pl.).
† Original Paper by A. Rodella, Padua, 1906.
‡ Ann. Inst. Pasteur, xxi. (1907) p. 20.

Identification of Bacillus mesentericus ruber.*—Th. Gruber describes the cultural aspects of this organism, and considers that diagnostically the growth on potato is most characteristic, consisting of a broad, finely-wrinkled, soft, slimy membrane of a beautiful rose colour, and having a strong odour of black currant.

Structure of the Bacillary Endospores.†—A. Guilliermond has studied the spore formation of *B. radicosus*, *B. mycoides*, *B. megaterium*, *B. limosus*, *B. alvei*, *B. arcterosporus*, and finds that at about the eighth hour the cytoplasm becomes vacuolated, and shows a fine alveolar stucture inclosing a number of various sized small granules situated at the nodes of the network. In some cases these granules are localised at the centre of each cell, giving a nuclear appearance; these granules may be regarded as of a chromatic nature.

At the time of sporulation there is formed at one pole of the cell a small deeply-stained mass, which soon becomes an oval spore, the cytoplasm remaining granular, and the spores not seeming to arise from a condensation of the granules. When the spore has reached a certain size it is surrounded by a hyaline zone, which becomes the spore membrane, the spore itself being now no longer stainable. The author does not hold with other writers that the spore is a true nucleus, and the hyaline zone the cytoplasm of the spore.

In some species (*B. alvei*) metachromatic corpuscles were very numerous, usually situated at the poles of the cells, and often reaching large dimensions, so as to give a moniliform aspect to the cell; occasionally only one of these granules is present, and when situated centrally has been erroneously described as a nucleus.

Cause of the Brown-red Pigment of Hard and Soft Cheese.‡—Th. Gruber finds that the cause of this coloration, which arose as a contamination in a North German cheese factory, is a pigment producing bacterium, *B. casei fusci*. Its growth on ordinary gelatin and agar plates was very slight, but on cheese gelatin at 16–20° C. good growth was obtained, the colonies being at first grey, compact, and hemispherical, later rosette-shaped and cream-coloured, becoming after three weeks of a brownish-yellow. The organism is non-motile, and does not form spores. Gelatin is slowly liquefied.

Lactic Acid and the Dairy Industry.§—Th. Gruber found that milk carefully obtained and allowed to stand in flasks at room temperature for several days become clotted. Stained preparations of this clot show true lactic acid bacteria, although in the freshly-drawn milk there were none obtainable by cultivation. By culture methods the author finds that lactic acid bacteria can be demonstrated in straw and grass, but not in cow-dung.

He isolated fourteen strains of lactic-acid-forming organisms, and has classed them into three divisions: those of the first group split up

* Centralbl. Bakt., 2te Abt. xvii. (1906) p. 644.
† Comptes Rendus Soc. Biol. de Paris, lxii. (1907) p. 78.
‡ Centralbl. Bakt., 2te Abt., xvii. (1907) p. 761.
§ Tom. cit., p. 755.

lactose and are indifferent to other sugars; those of the second group act on lactose and on dextrose; those of the third group act on lactose, dextrose, and on mannite.

Lactic Acid Bacteria (type Güntheri) from Various Sources.*—L. Müller finds that the different strains of *B. güntheri* show marked cultural and morphological differences, and have but little conformity in their relations to the various carbohydrates. The cultural properties and the power to form acid from sugars is the same with both *B. güntheri* and *Streptococcus agalactiæ*; under certain cultural conditions the streptococcus is morphologically indistinguishable from the bacterium, which also not infrequently takes a streptococcal form.

Form and Structure of Bacterial Colonies.†—H. B. Hutchison finds that the form of colonies lying deeply in a medium is dependent on the elasticity, cohesion, and superficial tension of the medium. The constitution of the superficial colonies depends especially on the cohesion of the growing cells and the surface of the medium. If the growth is accompanied with a secretion of slime, the colonies assume a spherical shape and shining appearance. If the cells in the centre of the colony lose their energy or die whilst the cells at the periphery continue to grow, a flattened growth results. The property of taking up water from the medium by the growing organism has also an influence on the shape of the colony, and on the motility of the bacteria. The growth of colonies, and the pigment formation, morphology and physiology of the cells, are influenced by light and air and by changes of temperature. The construction of the colonies depends not only on a regular arrangement of the cells, but on the constitution of the cell plasma.

Mutation of Bacteria.‡—R. Massini has observed a bacillus which gave colourless colonies on Endo's medium; by making repeated subcultures on Endo plates from one-day-old colonies, only colourless colonies were obtained, but if subcultures were made from three-day-old colourless colonies, the Endo plate showed both colourless and red colonies; these red colonies in subculture always formed red colonies. The author regards this as an instance of bacterial mutation, and has named the organism *B. coli mutabilis*.

Nitrogen Bacteria.§—H. Fischer considers that on morphological grounds, *Azotobacter* holds an intermediate position between *Streptococcus* and *Sarcina*, and should not on physiological grounds alone be regarded as a distinct species. The chief physiological character of this organism is that of fixing atmospheric nitrogen, so that it is able to develop in a medium that is completely free from nitrogen (nitrates, etc.). It grows well in media containing 0·1 p.c. potassium nitrate, and less well with ammonium sulphate, and with pepton 0·1 p.c. only slight growth; it grows badly, or not at all, on gelatin: on limited supply of

* Centralbl. Bakt., 2te Abt., xvii. (1907) p. 713.

† Op. cit., 2te Abt. xvii. (1906) p. 593.

‡ Verein. Mikro., Berlin, 1906. See also Centralbl. Bakt., 1te Abt. Orig., xxxviii. (1906) p. 98.

§ Verhandl. Naturhist. Vereins, Bonn, 1905, p. 135.

water the organism sporulates, the cell going into a resting phase, in which it may be air-dried for over a year without dying.

Anaerobic Form of Fränkel's Diplococcus.*—G. Bolognesi isolated from pleural exudate a capsulated coccus which in its morphological and pathological characters seemed to be identical with Fränkel's diplococcus. Culturally the organism was found to be a strict anaerobe. The author considers that under certain conditions the pneumococcus may become a strict anaerobe, and suggests that in many cases of pleural exudation which on aerobic cultivation have remained sterile, have been caused by the anaerobic type of Fränkel's diplococcus.

Anaerobic Bacteria with Diphtheria.†—K. Leiner has observed in cases of definite diphtheria, slender, pointed, Gram-negative rods, morphologically distinguishable from *B. fusiformis*, and probably identical with the pointed rods first described by Bernheim. The organism was also obtained in pure culture from several cases of septic diphtheria. The bacillus is a strict anaerobe. It grows on all media and emits a fœtid odour.

Influence of Moulds on the Intensity of Luminous Bacterial Cultures.‡—E. Friedberger and H. Doepner found that cultures of *Aspergillus fumigatus*, *A. niger*, *Mucor stolonifer*, *Penicillium glaucum*, and others, have the power of increasing the intensity of the light-production of light-emitting bacterial cultures, such as *B. phosphorescens* Molisch, and others. The observations were recorded on sensitised paper, and, by means of a special apparatus, the intensities of the blackened images of cultures, with and without the presence of the moulds, were compared and measured. The authors consider that the increase of light-intensity is caused by changes in reaction and also by some unknown vital property exerted by the moulds.

Ripening of Cheese.§—J. Boekhout and J. J. Ott de Vries find that the ripening of cheese commences with a lactic acid fermentation caused by micro-organisms, which sooner or later are killed by the lactic acid thus produced. Some of the micro-organisms have formed a proteolytic enzyme which is not destroyed by the lactic acid, and which survives in the cheese after the micro-organisms have ceased to develop, and which completes the ripening process. Cheese-ripening is thus due to enzyme action in combination with lactic acid fermentation.

Bacillus equi.‖—E. Klein describes a microbe which was isolated from the blood of a horse and was found to be pathogenic to Rodents. This organism, *B. equi*, morphologically resembles *B. pseudo-tuberculosis* Pfeiffer, and presents forms intermediate between a coccus and a filament. It is non-motile, non-liquefying, and non-Gram-staining. It does not form spores, and is devitalised by drying. It grows well at both 37° and 20°, the colonies being flat, moist, and translucent. It renders broth turbid, does not alter litmus milk, and forms acid from saccharose.

* Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) p. 113.
† Tom. cit., p. 119. ‡ Tom. cit., p. 1.
§ Op. cit., 2te Abt., xvii. (1906) p. 491.
‖ Lancet, 1906, i. p. 783.

De Novo Origin of Bacteria, Torulæ, and Moulds.*—H. Charlton Bastian presented this communication to the Royal Medical and Chirurgical Society. He had begun his experiments with various saline solutions containing ammoniacal salts, but after a time had found the best results were to be obtained with one or other of two solutions, one of which contained small quantities of sodium silicate, ammonium phosphate, and dilute phosphoric acid in distilled water, and the other a simple solution of sodium silicate with liquor ferri pernitratis in distilled water. The solutions were placed in previously superheated tubes, which, after being hermetically sealed, were heated again in a calcium chloride bath to 239° F. (115° C.), 248°, 257°, or 266° F. (130° C.), for 10–20 minutes. The tubes were subsequently exposed, either to diffuse daylight or else in the incubator, and mostly for periods varying from five weeks to four months. No carbon was ostensibly contained in the solutions. On examination of the contents of the tubes, organisms were found always on or within the substance of the flakes of silica, while the fluid above remained perfectly clear. The fluid would remain in this condition, and quite free from micro-organisms, even for months after organisms were known to be swarming in the silica itself. It was contended that there was good prima-facie evidence tending to show that silicon was capable of entering into the composition of protoplasm itself—that was, wholly or in part taking the place of carbon. It was concluded that the bacteria, bacilli, vibriones, micrococci, torulæ, and moulds which had been taken from hermetically-sealed tubes previously heated to 115°, 120°, 125°, and 130° C. for 10–20 minutes must have been engendered *de novo* within these vessels.

Action of the Bulgarian Ferment on Milk.†—G. Bertrand and G. Weisweiller, who have investigated the action of this ferment, isolated and described by Cohendy, find that it hydrolyses by means of an endolactose almost the whole of the milk-sugar, and then changes the resulting glucose and galactose into a mixture of lævo- and dextro-lactic acid, the latter predominating. Besides the lactic acid, which amounts to quite 25 grm. per litre, there are also formed small quantities of succinic acid, acetic acid, and probably a minute quantity of formic acid. This is the first real lactic-acid ferment known to produce succinic acid, and is also the first example of a lactic ferment which obviously splits up the lactose before transforming it into acid.

Tropism and Geotaxis of Bacterium Zopfii.—E. Sergent ‡ describes experiments made with *Bacterium zopfii* for the purpose of ascertaining what influences, such as gravity, elevation, position, etc., are the effective cause of the vegetation characters of this bacterium when grown on gelatin. Under certain conditions the cultures of *B. zopfii* present appearances very similar to a feather, while under others the growth is aborescent and ramified.

H. Zikes § has also investigated the cause of the plumule-like growth

* Brit. Med. Journ., 1907, p. 201.
† Ann. Inst. Pasteur, xx. (1906) pp. 977-90.
‡ Tom. cit., pp. 1005-17 (13 figs.).
§ Ueber geotaktische Bewegungen des Bacterium Zopfei, Wien, 1906.

of *B. zopfii*. He found that by placing the cultures on a rotating wheel this peculiar character was lost, and he therefore ascribes the feathery-looking growth to geotaxis.

Types of Bacilli of the Dysentery Group.*—Y. K. Ohno examined 74 strains of *B. dysenteriæ*, which, according to their fermenting action, he subdivided into 15 types. Experiments are also adduced as to the agglutinating action and the bacteriolytic action towards immune sera. Of these 15 groups nine fermented mannite and six did not (acid and non-acid forms). There was no correspondence between ferment groupings and the agglutinative and bacteriolytic action; thus, rabbit sera prepared from non-fermenting bacilli would agglutinate fermenting bacteria, and *vice versâ*. Similarly, there was crossed bacteriolysis. The general conclusion arrived at is that dysentery bacilli cannot be divided into two groups, the acid and non-acid, and disclaims the notion that if a bacillus cause dysentery it should be designated a pseudo-dysentery bacillus. The 15 types he describes as forming one group.

* Philippine Journ. Science, i. (1906) pp. 951–76.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Swift's Substage with Patent Slow Focusing.†—This substage (fig. 25) is fitted with the Climax slow focusing adjustment, and is

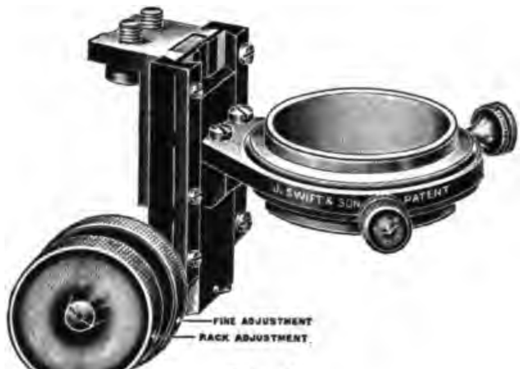

Fig. 25.

adapted for most of this maker's instruments. This apparatus is of great value for finally focusing when working upon a critical image. One entire revolution of the slow-adjustment drilled head moves the condenser 0·005 inch.

Fig. 26.

Swift's Turrell Mechanical Stage.‡—In this form of mechanical stage (fig. 26) both movements can be simultaneously used without removing the hand from its position. The bar against which the slide rests is removable, thus leaving the top plate of the stage free for the use

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Swift and Son's Special Catalogue, 1906.

‡ Tom. cit.

of Petri dishes or objects mounted on extra large slides. The stage is mounted on a base plate, which allows of the object being revolved concentrically in the field of view.

(2) Eye-pieces and Objectives.

Zeiss' Anastigmatic Magnifiers.*—Four lenses enter into the construction of these anastigmatic magnifiers (fig. 27), which have both a large field and large working distance. They are supplied in three different powers, 16, 20, and 27 diameters, either as single magnifiers in

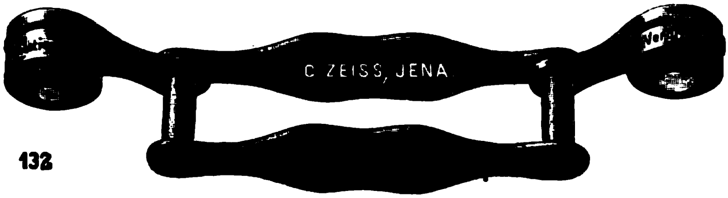

FIG. 27.

a mount suitable for dissecting stands, in the form of folding pocket lenses, or any two powers mounted in pairs, as shown in the illustration.

FIG. 28.

Zeiss' Verant Lenses.†—In these Verant lenses there is a virtual stop about 2·5 cm. behind the nearest lens surface, a sharp and un-

* Carl Zeiss' Special Catalogue, 1906, p. 6.

† Tom. cit., p. 7.

distorted image of a plane object being obtained; and in order that a proper and definite distance may be maintained during use, the instrument is provided with an eye-cap, which should be pressed close to the margin of the orbit, as shown in the illustration (fig. 28).

(3) Illuminating and other Apparatus.

Spectroscope for the "Allan Dick" Petrological Microscope.* This modification of spectroscope (fig. 29) will be found useful when examining minerals of the monazite class giving faint absorption bands; such bands can be seen best with a prism of moderate dispersion. The apparatus consists of a prism mounted to fit over the ocular. Fig. 30 is a brass plate with an adjustable slit, and working above this

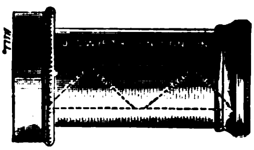

Fig. 29.

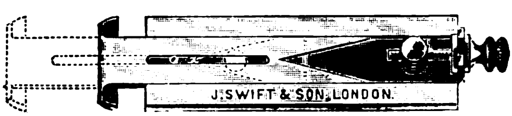

Fig. 30.

is a dovetailed plate with a V cut in the centre for restricting the length of the slit. On the right-hand side of the slit is a perforation for locating the object previous to pushing the slit into position. This piece of apparatus slides into the opening cut into the ocular just above the diaphragm. Made by Swift and Son.

Draper's Improved Dichroiscope.†—The improvement (fig. 31) consists of a revolving stage carrying a small cup filled with wax. The

Fig. 31.

crystal can be moved in the horizontal or vertical direction or brought into focus by means of the sliding tube carrying the prism eye-piece. The crystal can also be revolved on the horizontal and vertical axes

* Swift and Son's Special Catalogue, 1906, fig. 19. † Tom. cit., p. 27, fig. 22.

whilst under examination, and the crystal-holder can be thrown out of the field of view in order to fix the object to the wax. Made by Swift and Son.

Swift's Condenser for Illuminating Large Objects.*—This combination (fig. 32) is a modification of one of Swift's photographic lenses. It is

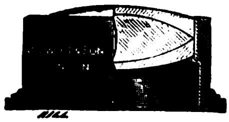

FIG. 32.

$1\frac{3}{10}$ in. in diameter, with an approximate focus of 2 in., and is intended for illuminating uniformly large objects under the lowest powers. The illuminator is mounted in a similar way to the spot lens, and focuses fairly close to the object. It is useful for photographing with Planars or any short-focus photographing lens.

Swift's Simple Hand Polarising Apparatus.†—This apparatus (fig. 33) consists of an analysing and polarising prism, with one lens

FIG. 33.

acting as a simple objective and another as convergent lens. The instrument is constructed for estimating the thickness of sections of minerals when being ground down to any given thickness previous to finishing them off as microscopic sections, the thickness being ascertained by polarising the mineral under observation.

Herbert Smith Refractometer.‡—The effective range of the refractometer (figs. 34, 35) is between 1·400 and 1·760, and the refractive

* Swift and Sons' Special Catalogue, 1906, p. 50, fig. 55.
† Tom. cit., p. 28, fig. 25. ‡ Tom. cit., p. 27, fig. 24.

indices can be determined within these limits to two limits in the third place of decimals, if a sodium flame be the source of illumination. The

Fig. 34.

Fig. 35.

instrument is calibrated by means of this light, and a table of indices corresponding to every division of the graduated scale within the effective range is supplied with the instrument. Made by Swift and Son.

(4) Photomicrography.

Photography in Natural Colours.—In the Journal for December 1906, p. 720, an abstract was given of G. Lippmann's new method of photography in natural colours. From correspondence which appeared in "Nature," * we note the curious coincidence that the method has been independently invented four times, it having been twice previously invented in this country and once in France. As the methods differ in certain details and suggestions, we give short abstracts.

F. W. Lanchester † takes a grating consisting of a number of opaque parallel bars, with spaces between less than the width of the bars, and places it between the camera and the object, and as near to the latter as possible, so that both are practically in focus on the photographic plate at the same time. The camera has a prism arranged in front or behind the lens, with its axis parallel to the bars of the grating, the dispersion being such that when the camera is focused on the grating the images of the slots form a series of spectra on the focusing screen or plate.

The bars of the grating are sufficiently numerous to prevent the picture being unduly broken or disjointed. In taking a photograph, an isochromatic plate is used; the resulting negative contains a record of the colours of the object in the form of shaded lines of varying intensity. A positive is then made on a lantern plate; this is placed in a similar or in the identical camera with which the photograph was taken, and in the position originally occupied by the photographic plate. The photograph now appears in natural colours, as soon as the grating is

* Oct. 4 and Nov. 29, 1906.

† English Patent Specification, No. 16548, 1895.

illuminated by a uniform source of white light. Reconstruction of the colour picture can also be effected by placing a lamp and condenser at the back of the lantern slide and projecting the picture on to a screen. In landscape photography, when the grating cannot be conveniently arranged near the objects being photographed, the picture is first projected on to the grating, by an additional objective. A field lens is then required between the two objectives. When taking the photograph a light filter is used to cut off the ultra-violet rays.

Julius Rheinberg * suggests the arrangement as above, in which the picture is first thrown on a grating of 300 lines per inch for example, with bars double the width of the spaces, the picture and grating being projected by the second objective, with a prism behind it, on to the photographic plate. It is pointed out that the method necessitates but a single negative, a single exposure, and no colour screens except an orthochromatic filter when taking the photograph. It might be looked upon as an extension of the Joly process of colour photography, the difference being that the artificial lines in three colours are replaced by real spectra produced optically. Regarding practical points, the grating used would require to have the dark interspaces perfectly opaque. The orthochromatic filter used would require to be such that the spectrum gave a deposit on the plate equal in density throughout its entire length. It would differ, therefore, from the ordinary orthochromatic filter, designed to fulfil the condition that the deposit on the plate corresponds to Maxwell's colour curve of visual luminosity. To view the photograph, a finely ground glass screen, or other light-diffusing medium, would have to be placed in contact with the positive. It is suggested that if, at a future date, paper ruled or printed with imitation spectra as fine as 150 per inch could be made, photographs could be produced in natural colours by this method, as easily and quickly as ordinary photographs at the present time.

Andre Cheron † describes his method, which is essentially similar to that described in the two foregoing abstracts, but he makes provision also for the use of a stereoscopic camera instead of an ordinary one. It is pointed out that as the positives are placed in the original camera for viewing purposes, it is a simple matter to place an ordinary stereoscope behind the pictures and see them in relief, the only further adjunct necessary being to have some large field lenses in contact with the positives. It is suggested that for stereoscopic work the lines of the grating should run horizontally in the one-lens system, and vertically in the other. To obtain exact colour registration when viewing the positives, the gratings can be moved by a micrometer screw.

Purifying Gelatin.‡—The following useful method is given in "Die Photographische Welt" for purifying gelatin for photographic purposes, and should be particularly useful for such as is to be used for making colour filters. The gelatin should be broken up into small pieces and soaked in water, which should be changed every half hour,

* British Journal of Photography, Jan. 1904, p. 7.
† French Patent Specification, March 1906.
‡ English Mechanic, lxxxiv., (1907) p. 627.

this being done at least ten times if the gelatin is a very poor sample. Finally, the gelatin should be melted by the aid of heat, and purified by the addition of egg-albumen. The whites of two eggs should be allowed for every pound of dry gelatin, and they should be beaten up to a froth, allowed to again become liquid, and then filtered and added to the cool liquid gelatin. Enough glacial acetic acid should be added to give the mixture a distinct acid reaction. The liquid should now be quickly heated to 212° F. and well stirred, when the whole of the albumen will be coagulated, and can be easily filtered out, carrying with it any solid impurities in the gelatin. The result is a perfectly clear limpid gelatin, which may be used as usual.

Note on Stereo-photomicrography.*—A. E. Smith describes three ways of making stereoscopic slides from microscopic objects.

1. The simplest way is to use an excentric Waterhouse stop just behind the objective. After taking a negative the stop is reversed, and another negative taken. The prints from these negatives are distinctly different, and will make good stereoscopic pairs. The author explains many of the practical details.

2. Another method, suitable for low powers only, is to tilt the object first one way and then the other, and secure a negative in each position.

3. The object may be moved a short distance across the stage, and a negative secured at either end of the movement. This necessitates the use of a larger camera, as the images do not come exactly in the same place.

The examples given range from 11–1500 diameters.

(5) Microscopical Optics and Manipulation.

Entoptic Vision.†—By means of this Entoptiscope, W. F. Barrett‡ has made further observations on the human eye especially in regard to Haidinger's Tufts, the Macula lutea, the Punctum cæcum, Purkinje's figures and and moving corpuscles. The entoptiscope, it will be remembered, is an instrument for the self-examination of one's eye. Its use has enabled the author not only to correct certain inaccurate ideas and measurements, but to ascertain new facts.

Haidinger's Tufts.—These are found to be precisely coincident with the Macula lutea.

Macula lutea.—Taking the nodal point as 16 mm. from the retina the horizontal diameter of the macula was found to be ·9 mm. and the vertical slightly less. The angle subtended by the yellow spot is a little over 3° (not 6–8°, as some authorities state).

Punctum cæcum and Purkinje's Figures.—The instrument lends itself admirably to observation of these phenomena.

Moving Corpuscles.—The author's observations favour the view that these are white blood-corpuscles, either in the retinal vessels or migrating from the capillaries. The rapidly moving points of light which are seen may be due to those corpuscles which are near the walls of the

* Journ. Quekett Micr. Club, ix. (1906) pp. 429–30 (2 figs. and 3 pls.); also in extract form.

† Sci. Proc. of Roy. Dublin Soc., xi. (1906) pp. 111–36 (3 pls.).

‡ See this Journal, 1906, p. 405.

capillary vessels acting as minute spherical lenses, and the larger specks with a slower and more wandering movement may be the amœboid movements of the white corpuscles which have escaped through the walls of the vessels.

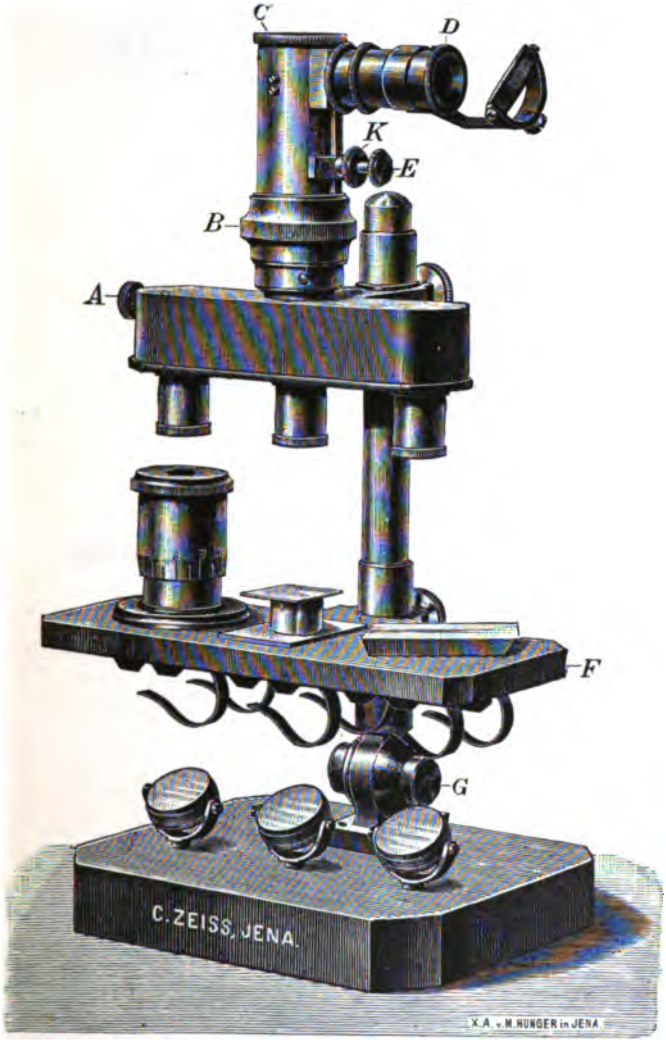

Fig. 36.

Zeiss' Comparison Spectroscope for Colour Technology.*—This apparatus (figs. 36, 37) is devised for simultaneously observing three

* Carl Zeiss' Special Catalogue, 1906, pp. 4–6.

spectra. The construction and manipulation of the instrument are essentially the same as in the laboratory spectroscope.* The absorption

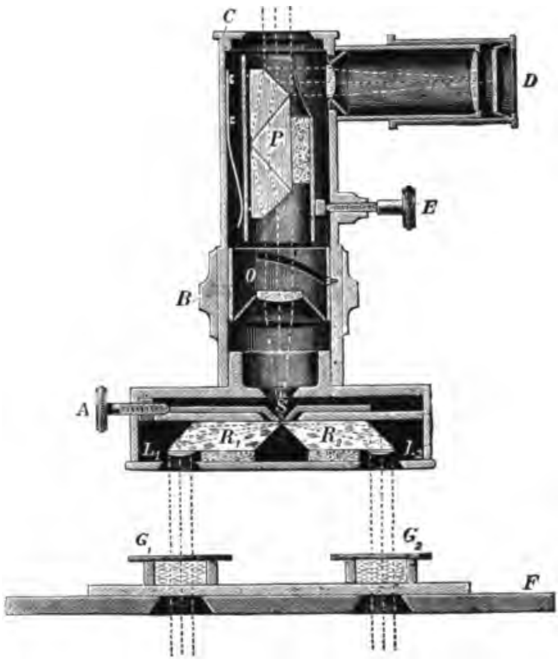

FIG. 37.

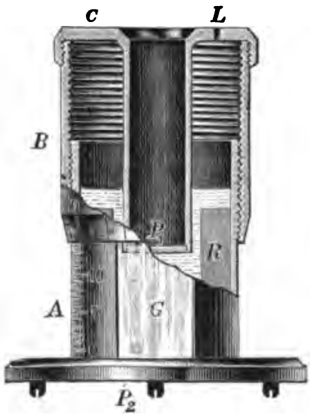

FIG 38.

vessel (fig. 38), in which the depth of fluid can be varied at will, is specially designed for measurement purposes. It unscrews into the four

* See this Journal, 1898, p. 477.

parts A B C R. The fluid is contained in the glass cylinder R, the floor of which is a glass plate. The plunger and cap are in one piece, C L P_1. P_1 is a glass plate, and L an air-hole. The vessel R is filled by unscrewing the cap. For ordinary fluids the plunger is made of metal, but for those with acid reaction or corrosive action, a glass cylinder is substituted. Full directions are given for manipulating the instrument and the absorption vessel.

Zeiss' Hand Spectroscopes.*—These hand spectroscopes are intended for the rapid examination of absorption and emission spectra. They

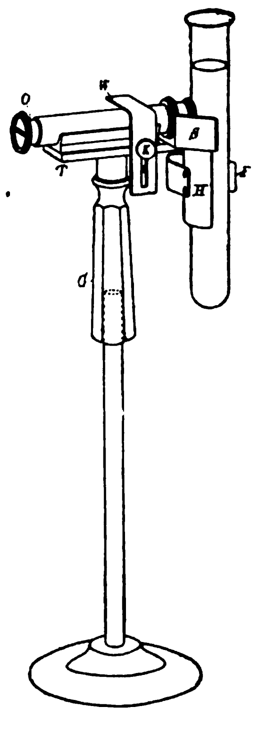

FIG. 39.

allow the whole spectrum to be viewed at a glance, and the slit is symmetrically adjustable. The position of a line is recognised by means of a comparison spectrum, or by a scale of wave-lengths, illuminated by the source of light. Fig. 39 shows the instrument one-fourth size: here it is seen clamped to a small table T by the piece W; on the underside of T is a bored-out handle, which serves to rest the apparatus on a pillar. S is the mirror for illuminating the comparison

* Carl Zeiss' Special Catalogue, 1906, pp. 6–7.

prism. In fig. 40 is seen a diagrammatic section of the instrument full size, with wave-length scale.

Ultramicroscopic Observations: The Characterisation of Inorganic Colloids.*—W. Biltz has carried out a series of ultramicroscopic experiments on very dilute solutions with the object of making observations on inorganic matter so finely divided as to be within appreciable reach of

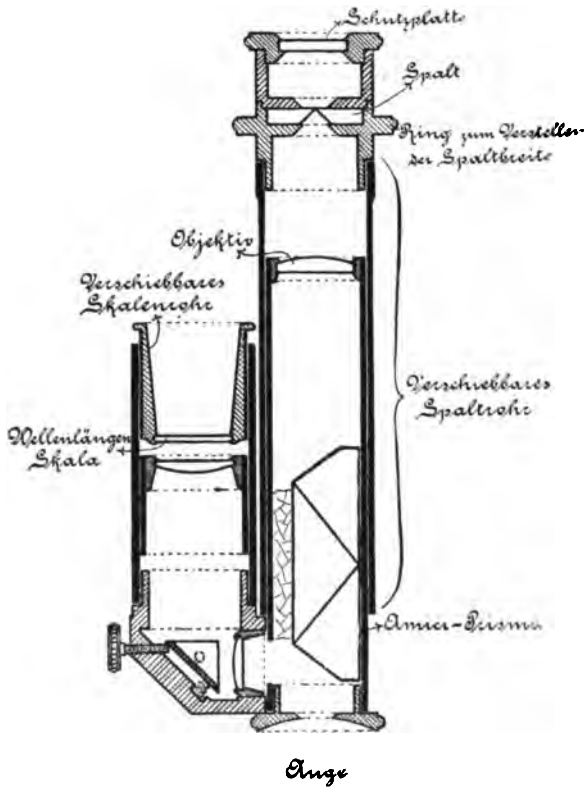

FIG. 40.

molecular division. In addition to completing some earlier investigations he wished to show in what way an ultramicroscopic image is dependent on the mode of preparation of the medium. Some of his previous work † had shown that in an ultramicroscopically discontinuous separation of elementary sulphur and selenium, an undoubted continuous formation of a colloidally suspended substance had taken place. This result naturally suggested further investigation.

* Nach. von d. König. Gesell. d.Wiss. zu Göttingen (Math.-Phys. Klasse, 1906) pp. 141–56.

† Op. cit., 1904, p. 300.

In the present series of experiments the depth of the illuminated part of the solutions was kept smaller than before and restricted to 10–12 μ, so that in an image-breadth of 27 μ, a cross-section of about 300μ^2 was illuminated. The net in the ocular of the observation microscope contained eighteen squares, and corresponded to 18 $\times$ (9 μ)^2 of an upper plane on the object. The net therefore covered an illuminated volume of 11 $\times$ 18 $\times$ 81 μ^3 (roughly 16000 μ^3); and a single square would cover about 890 μ^3. The task of counting reduces itself, in the case of solutions rich in particles, to estimation of those on one square; in the case of weaker solutions, to those on the whole net; while, in the case of fairly empty solutions, those in the entire field (about five times the size of the net) must be counted. In the observations special attention was paid to the number of particles, their movement, their colour, and their brightness; also to the determination of the relative number of the particles of differing colour and brightness and to the age of the solution under examination. The author adopts Siedentoff and Zsigmondy's terms *Submicrons* and *Amicrons*; the former means particles ultramicroscopically perceptible; the latter, those beyond the reach of the ultramicroscope. The author gives in seven tables the results of his efforts.

Iris of Optical Systems.*—A. E. Conrady explains a certain peculiarity of microscopic images referred to by J. Rheinberg,† viz. that when two objects of exactly the same size were placed at different distances from the object-glass (but within reach of its depth of focus), the more distant one was not always depicted as the smaller, but did sometimes actually yield the larger image. As a rule, there is in every optical system one aperture which limits the diameter of the cone of rays passing from any point in the object to the conjugate point in the image. This aperture Abbe called the iris of the system. By means of diagrams the author shows that the images are reversed according as the aperture is placed in front of the object-glass or behind its upper focal plane. There is an important intermediate case, viz. when the iris is placed exactly in the upper focal plane, the consequence being that only those rays can pass which had been parallel to the optical axis before entering the object-glass. The image so produced is definite and unchangeable. Professor Abbe was the first to point out the value of this arrangement for measuring instruments, and introduced the term "telecentric" for object-glasses with the limiting stop in this particular position.

On Stereoscopic Effect and a Suggested Improvement in Binocular Microscopes.‡—Julius Rheinberg, after pointing out that a proper understanding of the subject implies adequate recognition of the fact that stereoscopic vision with the Microscope means viewing objects in three dimensions, of which only a single plane is in perfectly true focus at any one time, passes on to show that points in all other planes are represented in the view plane by diffusion disks, which may vary not only in size, but in shape and position. It is shown that their size

* Journ. Quekett Micr. Club, ix. (1906) pp. 440–2 (3 figs.).
† Tom. cit., p. 375.
‡ Tom. cit., pp. 371–96 (9 figs.).

depends on the free aperture of the objective, that when part of an objective only is utilised, the shape of the diffusion disks is the same as that of the part used (which had not hitherto been adequately recognised), and that their position is likewise determined by the part of the objective used, e.g. when the right half only of an objective is used, points nearer than the plane in true focus get shifted to the right, points further away get shifted to the left. Then follows a lengthy review and comparison of the various causes which operate to give the impression of solidity and plasticity in naked-eye vision, and those which come into play in stereoscopic vision with the Microscope. The subject is treated very fully, experiments being suggested to illustrate the various points. After this comes a discussion of the various forms of binocular Microscopes. They are divided into two classes, those in which separate objectives are used—of which the Greenough Microscope, made by Messrs. Zeiss, is the best example—and those in which separate parts of a single objective are utilised, as in the Riddell, Wenham, and Stephenson form of binocular, and the Abbe stereoscopic eye-piece. Regarding the second class, it is pointed out that:

"On this very simple property, that parts of an objective used by themselves bodily shift the image of any area lying in a plane at right angles to the optic axis of the whole lens, *without any change of actual shape*, depends the stereoscopic effect of the contrivances we are considering. If we may talk of the different parts of an objective as 'looking at' an object, we might say that no separate part of an objective can 'look' along any other direction than one parallel to the optic axis of the whole lens—a very different matter from 'looking at' the object from the actual direction of the part of the object utilised, in which case the object squares we are considering just now would be foreshortened, and assume different shapes according to the point from which they were regarded. Helmholtz appears to have recognised, almost half a century ago, the peculiar manner in which the different parts of an objective 'look at' and 'see' the object, for in his 'Physiological Optics' the action of Nachet's binocular Microscope is explained as due to the causes stated, in a few crisp and short sentences. But no better proof can be given that his explanations were not understood till a much later date, than that Naegeli and Schwendener, in their well-known work on the Microscope, dismiss Helmholtz' remarks in a short footnote as being incorrect.

"The first to explain the whole matter at length was Abbe, who, in a series of papers in 1881 and 1882, notably in his paper 'On the Mode of Vision with Objectives of Wide Aperture,' clearly showed how the lateral shifting of the images of different planes of the object by different parts of the objectivé constitutes a particular form of parallactic displacements."

Reference is then made to the controversies on the subject both before and after Abbe's paper, the latter, which the author follows, being explained in detail, and it is shown that the truth of the theory is amply confirmed by the diversified action which can be obtained by the Abbe binocular eyepiece.

Being led to a study of the subject of stereoscopic effect with the

Microscope by the stereo-photomicrographs taken by Mr. H. Taverner, by means of excentric circular stops placed behind the objective, Mr. Rheinberg saw that the same method might be applied to binocular microscopes. His justification for this is given in the following extract from the paper—

"If parallactic displacements of out-of-true-focus layers of the object constitute the mechanism by which stereoscopic effect is produced, this in itself furnishes the necessary proof that the whole image, barring the one plane in true focus, consists of diffusion disks. The size and shape of these diffusion disks is therefore an important matter. We saw in the first part of this paper that the size of the diffusion disk varies directly as the size of the portion of the objective used; further, we saw that the shape it assumes is the same as that of the portion of the objective utilised. It is evident, therefore, that to have pictures of maximum clearness it is desirable to have these disks as small as the circumstances permit, and also that they should be circular in shape. At present, in binocular Microscopes no regard is paid to either of these matters; the size of the diffusion disks is not adapted according to the depth of the object to be viewed, and the image is formed of overlapping disks semicircular in shape. An unsymmetrical shape like this results in the image of the same object being less distinct in certain directions than in others, or varying in distinctness according to the position in which it happens to lie in the field.

"How it has come about that these matters have been overlooked is simple enough. As regards Microscope images, attention has been chiefly concentrated—and justly so—on the perfection of the image of the object layer in true and perfect focus in the view plane, and for this particular plane other conditions prevail. It is the one layer which is free from parallactic displacement, no matter which part of the objective may be used. It is also the layer for which the laws framed from the study of the diffraction of light apply more particularly. And one of these laws is that the 'diffraction disks,' of which the image in this plane is composed, vary inversely in size with the aperture of the objective (or of the part of the objective) utilised. Smaller disks mean greater resolving power so long as the image magnification remains unaltered; therefore, for this one plane, the larger the aperture of the objective employed, the better the images, and the largest aperture available in binoculars is the half-objective. An instructive experiment consists in viewing a Grayson band plate with a binocular Microscope. The effect of the semicircular shape of the half-objective may then be shown by rotating the plate. When the rulings lie in the direction of the straight edge of the half-objective, a band with only about half the number of lines per inch is resolved as when they lie in the direction at right angles to this.

"Although within certain limits the same principles hold good with respect to slightly out-of-focus layers, the general feature remains that diametrically opposite conditions apply, as regards diminishing the size of the disks, when the layer of the object is in true focus and when it is not. The one necessitates the employment of parts of the objective aperture as large as possible; the other requires them to be as small as possible.

"To which are we to give more weight, bearing in mind that the essence of stereoscopic effect lies in viewing a great number of planes simultaneously? Should we adapt our instrument for the single plane in true focus, or for all those others seen at the same time? I think you will find it rational—the more so as, even in the single plane, we cannot secure equally good resolution in all directions—that we should extend a good deal of consideration to all those other layers; and the best rule to be followed—one which I believe Mr. Taverner, from his experiments in stereoscopic photomicrogaphy, has also arrived at—is: use circular stops (as in fig. 41), having them just small enough to secure a moderately fair image of the deepest layers which it is required to see simultaneously with the others. In other words, get the necessary depth of focus, but no more; for in securing more, the perfection of the image in other parts is being decreased. Similar objects being exhibited under binocular Microscopes in which this rule has been followed, and under others in which the two halves of the objec-

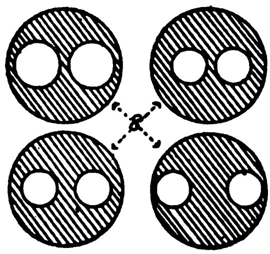

FIG. 41.

tive are left as usual, the improved effect in the former is perceptible at a glance."

The best position for the stops is discussed, and it is suggested that immediately below the Wenham or Riddell prism is the most suitable place, and that a sliding carrier for the stops in this position would be the most convenient plan.

After touching on the difficulties connected with stereoscopic effect, when high powers are used, the paper concludes with remarks on the points of difference between stereoscopic vision with binocular Microscopes and stereoscopic photomicrography.

(6) Miscellaneous.

Mendelism and Microscopy.*—D. J. Scourfield, in the course of a paper on the above subject, suggests that systematic researches on microscopic creatures might do much to correct and extend our knowledge of Mendelism. It is necessary that such creatures should be bisexual, and not too small to prevent the isolation and control of individuals. Their small size would make it possible to carry on

* Journ. Quekett Micr. Club, ix. (1906) pp. 395–422; also in extract form.

extensive experiments in a small space and in a very inexpensive way. Most of them, also, are very quick and prolific breeders, and many generations could be obtained in the course of a year. Then, with regard to the simultaneous study of the germ-cells and body characters, it would probably be found that they would provide much better material than larger animals and plants. Lastly, it would be of the highest theoretical importance to trace the course of heredity of particular characters in cases where parthenogenesis occurs, and such cases can, of course, most easily be found among microscopic animals. The author mentions certain species of Entomostraca, Aphides, and Rotifers, as likely to be suitable subjects. He adds a bibliography of Mendelism.

Quekett Microscopical Club.—The 436th Ordinary Meeting of the Club was held on January 18, the Right Hon. Sir Ford North, F.R.S., Vice-President, in the chair. Mr. T. B. Rosseter, F.R.M.S., contributed a highly technical paper on two Avian tapeworms, *Hymenolepis nitida* and *H. nitidulans*. Mr. A. E. Hilton read a paper "On the Nature of Living Organisms," which gave rise to some interesting discussion.

The 437th Ordinary Meeting, which was also the 41st Annual General Meeting, was held on February 15. The President, Dr. E. J. Spitta, F.R.A.S., F.R.M.S., etc., delivered an address, illustrated by a number of very fine lantern photographs, on "A Review of Photomicrography." This dealt with early attempts and early difficulties, the great advances consequent on the introduction by Abbe of the apochromat and semi-apochromat, and the recent important improvements effected in the manufacture of plates and contrast-screens.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Cultivation of Root Bacteria.†—A. Rodella adopts the following method for cultivating anaerobic root bacteria:—A root tubercle is washed in distilled water, in 1 p.c. perchloride, and again in sterilised distilled water. It is then transferred to a Burri tube, or ordinary test tube containing glucose-agar; this is exposed to 80° C. for 5 minutes, and after being cooled is incubated at 37° C. for 2–6 days (the tubercle being at the bottom of the tube). Much gas is developed, so that "the whole column of agar will be driven towards the mouth of the test tube." The process is repeated several times in order to obtain a pure culture.

Fresh milk serum is poured into a sterilised wine flask, with a neck about 50 cm. long, until the flask is half full; it is then raised to 60° C., and the entire agar culture, as obtained above, is introduced; more sterilised serum, heated to 60° C., is now added until the flask is filled to within 10 cm. of the mouth; 5 c.cm. of sterilised oil is now poured on to the surface of the liquid, and the whole is placed in a thermostat.

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.

† Original Paper by A. Rodella, Padua, 1906.

Fermentation will be apparent before the third day. Cultures thus obtained can be poured on to the soil to be treated.

Quantitative Estimation of Bacterial Mass by the Colorimetric Method.*—J. Zelikow employs the colorimeter of Dubosc to estimate the quantity of bacteria in a culture. The instrument (fig. 42) consists of two beakers C to hold the stained solutions; the niveaux are regulated by the sinking of a polished glass prism T, the position of which is measured; light is reflected from mirror M, passed through the coloured solutions, and then reflected by the prism P, so that each beaker will correspond to one half of the field of vision, and the absorption of stain in the two columns of coloured solution may be simultaneously compared. Two flasks of bouillon are inoculated with culture; after 24 hours the contents of one is passed through a filter; from the filtrate and also from the unfiltered content of the other flask, emulsions are made; to definite volumes of these, and also to the pure bouillon, definite amounts of stain are added; the whole is heated at 70°–80° C. for an hour, and then centrifuged; the solutions are then drawn off, and the amount of stain absorbed is estimated by the colorimeter. The author gives various precautions to be taken in applying the method.

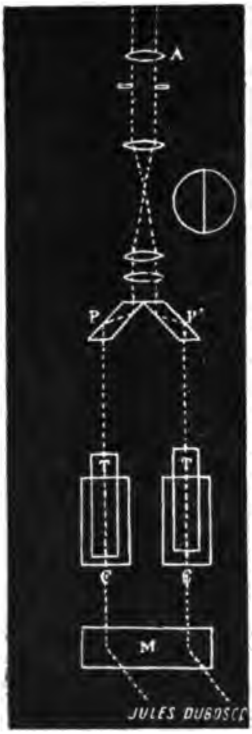

Fig. 42.

Anaerobic Microbes of Water.†—H. Vincent advocates the following method for enumerating and isolating the true anaerobic microbes of water. The medium consists of gelatin 50–75 grm., glucose 5 grm., glycerin 5 grm., peptonised beef broth 500 c.cm., the whole being neutralised, and at the time of using a sufficient quantity of sulpho-indigotate of soda is added.

If the water is probably impure it is added to the medium in amounts of 0·05, 0·02, to 0·01 c.cm.; if likely to be pure, in amounts of 0·5, 1, or 2 c.cm., the medium being previously boiled and brought to a temperature of 30°–35° C. The mixtures being made are then drawn up into 50 cm. pipettes of diameter 3–4 mm.; these when filled are sealed at both ends and held in a stream of cold water to fix the gelatin.

The strict anaerobes forming diffusely contoured, flocculent, granular colonies, and secreting more gas, are readily distinguished from the facultative anaerobes that form compact limited opaque colonies.

* Centralbl. Bakt., 1te Abt. Orig., xlii. (1906) p. 476 (1 fig.).
† Ann. Inst. Pasteur, xxi. (1907) p. 62.

Reaction of Mammalian and Avian Tubercle Broth Cultures.*—O. Bang by growing cultures in very small amounts of medium, and also by employing flasks whereby the lower strata of the media could be readily examined, was able to show by the reaction curves that the substrata of the broth in the cultures of bovine and also of avian tubercle became more alkaline, whereas the similar curves of human tubercle culture reaction showed, after an initial fall towards or below the neutral point, an increased acidity. The author found that the reaction curves depended on the amount of the medium in the culture flask, on the age of the culture, and on the original reaction of the medium.

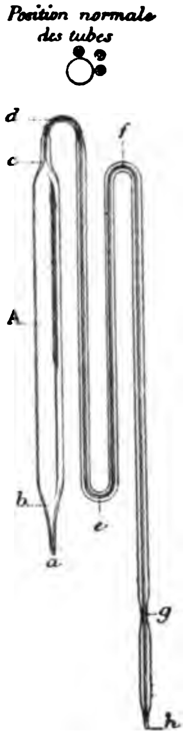

Fig. 43.

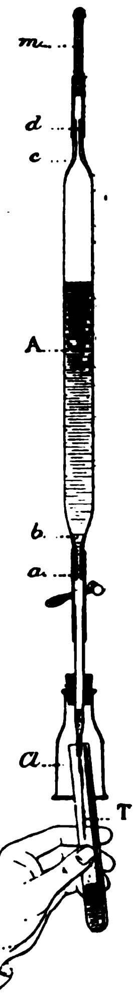

Fig. 44.

Collecting Sea-water for Bacteriological Study.†—P. Portier and J. Richard describe an apparatus which consists of a cylindrical glass vessel A, 86 cm. long and 16 mm. in diameter (fig. 43), the wall being sufficiently thick to resist a pressure of at least 600 atmospheres. The vessel ends below in a short capillary tube *a b*, and above in a long capillary tube *c d*, *e f*, *g h*, with three bends. A drop of water is introduced into the ampoule A; the end *a* is then closed in the flame, and the long capillary tube connected with a mercury pump to exhaust the air. When a vacuum is obtained, the tube is closed at *h*. The exhausted tube is then sterilised at 120°. This done, it is inserted in a metal box, being fixed with copper wire in such a way that the point *g h* projects from the upper end of the box. The apparatus is then attached to the plummet line, and let down to the desired depth. By means of a messenger sent down on the plummet line, the box is set free from the collar, it turns over, and the projecting tube strikes an iron bar, whereby it is broken at the constriction *g*. The apparatus then fills with sea-water. It is then drawn up, and as it nears the surface it becomes warmer; in consequence, a fine stream issues from *g*, and this serves to

* Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) p. 34.
† Comptes Rendus, cxlii. (1906) pp. 1109–1111 (4 figs.).

prevent entrance of contaminating germs. Arrived on board, the point at *a* is filed off, and the arrangement shown in fig. 44 is attached; the upper end is then filed through at *d*, the bends are rejected, and a tube filled with cotton wool at one end is fitted on at *d c*. On loosening the pinchcock, the contents of A are removed to vessels filled with cultivation media.

New Cultivation Medium for Bacteria.*—Uyeda finds that mannan makes an excellent medium for cultivating bacteria. In Konjaku plants (*Conophallus konjak*) it occurs in considerable quantity, and is obtained by boiling the roots, when it forms a jelly of the consistence of stiff starch paste. In Japan it is a commercial article and is sold in sheets. For laboratory purposes it is used like ordinary gelatin, i.e. by itself, or to aid in stiffening other media. Bacteria show characteristic growth, liquefaction and pigment formation when cultivated on this medium.

Collecting and Preserving Relict Crustaceans.†—W. Samter and W. Weltner used drag-nets and push-nets of different shapes for capturing *Mysis relicta*. One drag-net was 120 cm. long, and the iron collar was shaped like an isosceles triangle, one side being 80 cm. the others 50 cm. each. Another triangular net was equilateral, the length of the bars being 50 cm., and the length of the net sac 70 cm. The third drag-net was rectangular, the long sides measuring 65 cm. and the short 18 cm.; the length of the bag, which was triangular in shape, was 107 cm. The push-net or scraper was much like a hay-fork, the prongs of which are joined by a bar 25 cm. long.

The animals were fixed and preserved in alcohol and formalin. The latter (1 part commercial formalin to 10 parts of water) gave the best results.

Volvox for Laboratory Use.‡—B. G. Smith has found that *Volvox* can be kept for weeks by means of the following procedure. The water containing *Volvox* should be brought in in considerable quantity, together with a small amount of vegetable material, such as duckweed, *Riccia*, etc., and placed in shallow glass dishes. The dishes are placed near windows and covered with glass plates, except when exposed to direct sunlight. In that case it is advisable to leave room for circulation of air between the cover and the dish, to prevent rise of temperature beyond the optimum. The water need not be changed. Should there be too many inimical organisms present the *Volvox* may be removed to another vessel, filled with water which has been freed from Crustacea, etc., by filtering it through bolting cloth. A moderate amount of decaying plant or animal matter seems necessary for the existence of *Volvox*, and they are more easily kept alive in cool than in warm weather.

Abundant material in the sexual stage was obtained in the spring and fall, and it was noted that when in this condition they often remain hidden in the ooze at the bottom of the dish.

* Bull. Imp. Centr. Agric. Exp. Stat. Japan, i. (1906) p. 59. See also Centralbl. Bakt., 1te Abt. Ref., xxxix. (1907) p. 300.
† Arch. f. Natur., i. (1906), pp. 311–22 (2 pls.).
‡ Amer. Naturalist, xli. (1907) pp. 31–4.

Reiser's Bacterial Filter for Small Quantities of Fluid.*—To the bougie F (fig. 45) is closely adapted a glass cylinder ending above as a tube A, connected with a piece of rubber tubing. Between the filter and the glass cylinder is merely a capillary space so that when the apparatus is set working the fluid can be filtered to the last drop. To the bottom of the cylinder is fitted a brush K, which cleans the filter from bacterial slime.

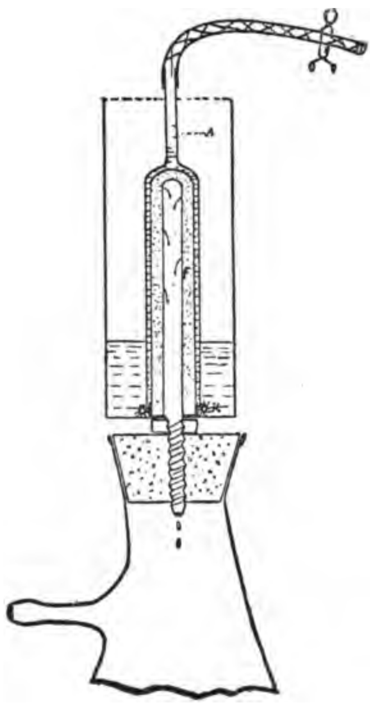

FIG. 45.

Studying Fecundation in Serpula.†—A. Soulier points out that artificial fecundation in *Serpula* is facile and constant; it is easily obtainable throughout the year. It is quite sufficient to place the male and female genital products on a watch glass; fecundation takes place and development follows its normal course.

The ovules are picked out at various stages of evolution (5, 10, 15 minutes, and so on) and then placed in a fixative.

A temperature not exceeding 15° is advised for observing the normal fecundation course. If from 12°–15°, fecundation takes place in from 30–45 minutes after the sexual elements have been mixed together. Segmentation follows within 5 hours after. By the second and third day the larval organs are complete. If the temperature be 8°, fecundation takes 3 hours, and other stages in proportion.

Numerous fixatives were used, the least unsuccessful ones being the fluids of Flemming, Fol, and Cori. The successful ones were Gilson's, Roule's, and Ripart and Petit's. All these last three gave excellent results provided they were diluted to 1 part fixative to 3 of sea water.

The sections were stained with picrocarmin, safranin, etc., according to the procedures ordinarily used by histologists. Double staining with hæmatoxylin and eosin gave excellent results.

Simple Steam Steriliser and Hot-water Filter.‡—This apparatus (fig. 46) has been devised by A. Frazer to meet the requirements of those who wish to conduct the operations of sterilising and filtering in a single vessel of small size and moderate cost. The apparatus is of the ordinary shape, while the height of the cylinder is 16 in. and the

* Chem. Zeit., xxx. (1906) p. 686. See also Deutsch. Mechaniken-Zeit., 1906, p. 206. † Arch. Zool. Expér., v. (1906) pp. 403-89 (1 pl. and 21 figs. in text).
‡ Proc. Scot. Micr. Soc., iv. (1906) pp. 68-9 (1 fig.).

diameter 7 in. There is a perforated platform about 2 in. from the bottom in which any flask of the size of 1 litre can be placed. About 1 in. from the top there is a circular ring which serves to support an enamelled funnel used for hot-water filtration. By conducting the filtration entirely within a heated chamber the difficulty of keeping the neck of a hot-water funnel sufficiently warm is entirely obviated. The apparatus is arranged for use with an ordinary Bunsen burner, but can be worked efficiently by an Etna blow-lamp.

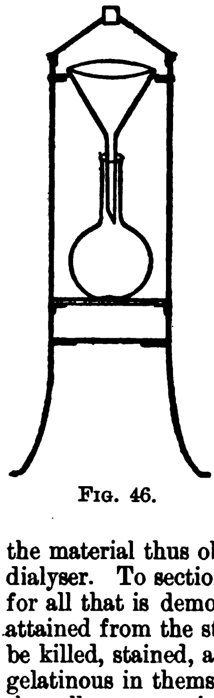

FIG. 46.

Collecting and Preparing Cyanophyceæ.* — N. L. Gardner removed the coarse impurities by the decantation method. The material was then placed in jars in the shade until it had crawled to the centre in a mass. When placed in direct sunlight the mass, owing to the formation of gas, floats to the surface. From the margin new clean growth is formed and this is removed with scissors. In order to get the filaments into a small mass for imbedding they are repeatedly sucked into and forced out of a pipette until thoroughly broken up. On standing for a few hours in the shade they will be found to have crawled together again into a single mass, and in this condition may be killed and imbedded in paraffin for sectioning. Small species scattered among fine debris were cleansed by centrifuging and then decanting off the supernatant fluid and filtering. After the material thus obtained has been washed, it may be dehydrated in a dialyser. To sections of prepared material the author prefers uncut tissue, for all that is demonstrable by the former procedure can be more easily attained from the staining and mounting of uncut cells. The cells may be killed, stained, and fixed to the slide with albumen if not sufficiently gelatinous in themselves, e.g. *Oscillatoria*. In order to kill and separate the cells a strong iodo-potassic iodide solution is advised; 10–30 minutes or longer will not hurt the plants. The material is then washed with 95 p.c. alcohol and afterwards with water. The cells break apart and adhere well to the slide. Besides iodo-potassic-iodide, 95 p.c. alcohol, Flemming's and Hermann's solutions, sublimate, 1 p.c. chromic acid, and iridium chloride were used as killing and fixative agents. A very long list of staining reagents is given, most of them being anilin derivatives, though the varieties of carmin and of hæmatoxylin are also included. A variant of the Ehrlich hæmatoxylin gave good results. In this Grübler's hæmatin was substituted for hæmatoxylin. This solution was effective as a simultaneous killing and staining agent, and differentiated well after a variety of fixatives.

(2) Preparing Objects.

Studying the Vitellus.†—H. Dubuisson removed the organs from living animals, using an anæsthetic when necessary. The fixative chiefly

* Univ. California Publications (Botany), ii. (1906) pp. 237–96 (6 pls.).
† Arch. Zool. Expér., v. (1906) pp. 153–402 (52 figs.).

used was Bouin's picro-formalin, but for small ovaries Rabl's picro-sublimate was preferable. Flemming's and Borrel's fluids were also employed, but only for small ovules. The material was then passed through upgraded alcohols (30°–80°), 24 hours each. For imbedding, chloroform was used as the solvent for paraffin (m.p. 38°). Heidenhain's bisulphide of carbon method was also employed for imbedding.* The advantage of this procedure consists in the shortening of the heating time. The paraffin sections were stuck on by the albumen method, the paraffin removed by toluene and the picric acid and toluene by alcohol. As a nuclear stain hæmalum served the purpose best. The cytoplasm stains used were (1) aqueous solution of eosin; (2) acid-fuchsin; (3) Squire's acid-fuchsin and orange; (4) modification of Pappenheim's stain (eosin 6, orange 4, aurantia 1, distilled water 500). Some of the foregoing lose their colour during dehydration, but this inconvenience may be avoided by a previous washing in water slightly acidulated with acetic or hydrochloric acid.

Another nuclear stain was the following: indigo-carmin 0·25, saturated solution of picric acid 100. For the osmic acid preparations the author used safranin and magenta-red as nuclear stain, picro-indigo-carmin and light green for the cytoplasm.

Studying the Structure of Spinal Ganglia.†—M. v. Lenhossék made the chief object of his research the spinal ganglia of adult men, but also examined the ganglia of infants, cats, dogs, horses, and cattle. Small ganglia were immersed entire, large ones were cut in half and immersed for 24 hours in the following mixture: alcohol 96 p.c. 100, ammonia 0·5. The pieces, after a rapid wash in distilled water, were placed in 2 p.c. silver-nitrate solution, and incubated for 3 days at 35°. The pieces, on removal, were washed in distilled water and exposed at room temperature to daylight for 24 hours in the following mixture: pyrogallic acid 1·5, distilled water 100, formalin 5. After dehydration the pieces were imbedded in paraffin and sectioned. The sections are then (after the paraffin has been removed in the usual way) treated with gold solution prepared as follows:—to 150 c.cm. of distilled water, 4 c.cm. of the ordinary 1 p.c. gold chloride solution are added. After an immersion of 10 minutes to an hour in order to exchange the silver for gold, a point recognisable by the naked eye by the alteration from a brown hue to a steely-grey hue, the preparations are treated for some minutes with a 5 p.c. solution of soda-fixative. This done, they are thoroughly washed in running water. The transfer of gold for silver may be more safely ascertained by watching the process under the Microscope. The sections may, in addition, be contrast-stained with Mayer's carmalum.

Fixation of Red Blood Corpuscles.‡—F. Weidenreich fixes the red corpuscles in the following way. Some 1 p.c. osmic acid is placed in shallow glass vessels, and the slides to be used are exposed to the vapour for 1 minute. The blood obtained from a clean finger tip is then run

* See this Journal, 1902, p. 111.
† Arch. Mikr. Anat. u. Entwickl., lxix. (1906) pp. 245–63 (2 pls.).
‡ Tom. cit., pp. 389–438 (2 pls.).

over the surface of that side of the slide which has been exposed to the vapour, and a film made. The film side is then at once exposed to the vapour for ¼–½ minute and then allowed to dry in the air. It can then be examined in water. If a permanent preparation be desired, the film must be stained. The stains recommended are Ehrlich's tri-acid, and Giemsa's solutions.

Studying Ascomycetes.*—J. H. Faull, in his study of development of ascus and spore formation in Ascomycetes, used several fixatives, but found that Flemming's weaker solution was the most satisfactory. As stains, Flemming's triple stain of safranin, gentian-violet and orange G, and Heidenhain's iron-hæmatoxylin were superior to all others, but no hard and fast rule can be laid down, as each species requires special staining treatment. Paraffin (m.p. 57°) was used for imbedding, and the sections were from 3–5 μ thick.

In determining the origin of the ascus it was frequently of advantage to crush slices of fresh or preserved material, preferably the latter, and examine in water or potash.

Studying the Anatomy of Boophilus Annulatus.†—S. R. Williams killed the material (gravid females, immature females and males) in hot water, Perenyi's corrosive-acetic, Carnoy's and Hermann's fluids. Poor sections were obtained from fresh material owing to the thick chitinous investment. But with museum specimens which had been kept in spirit for ten years, sections serviceable for study of the general form of organs were obtained by dissecting off the cuticula. The cytological condition was indifferent, but the series were perfect and easily obtained. The suggestion is made that adult females should be fixed in warm solutions and then left in strong alcohol for some days, so that, owing to shrinkage, the chitin can be dissected off with fine needles under a Microscope.

Studying the Anatomy of Mosquito.‡—M. T. Thompson cut off the dorsum of the thorax while the insect was immersed in the fixative. The reagent used was Gilson's fluid, made as follows: 70 p.c. alcohol, 10 parts; distilled water, 86 parts; corrosive sublimate, 2 parts; glacial acetic-acid, ½ part; nitric acid (80 p.c.) 1½ part. Before immersion in the warm Gilson's fluid, the insect was dipped in alcohol to remove air from the scales. Serial sections were cut in the three planes usually employed. Other sections, 30 μ, were made from material fixed in Flemming's fluid, and were mounted without further staining than that derived from the fixative. An excellent method of mounting the whole head of the larva is to stain with picro-carmin and clear with Weigert's fluid.

The pupa stage was studied from serial sections of a series of specimens of known age. Such a series was obtained by segregating mature larvæ in a dish, and each hour removing all pupæ to separate containers in which they could be reared for any desired number of hours.

* Proc. Boston Soc. Nat. Hist., xxxii. (1905) pp. 77–113 (5 pls.).
† Tom. cit., pp. 313–34 (5 pls.). ‡ Tom. cit., pp. 145–202 (6 pls.).

Histology of Uterine Mucosa of Viviparous Sharks and Rays.*— A. Brinkmann fixed the material in the following solutions: (1) Saturated aqueous solution of sublimate in normal salt water, plus 3–5 p.c. acetic acid. (2) 10 p.c. formalin (1 part commercial formalin, plus 3 parts water). (3) Flemming's strong mixture. (4) Hermann's mixture. (5) A mixture of equal parts of No. 1 without the acetic-acid and of No. 2. The last solution gave very satisfactory results. As often as possible the material was pinned to cork, and in order to keep the uterus in its natural shape, P. Mayer's method for fixing intestine was adopted. A glass tube was tied to both ends of the uterus. To the tubes were fixed pieces of rubber tubing supplied with pinchcocks, so that fluid could be run through or retained at will. The uterus was first washed out with 0·75 salt solution and then treated with fixative, usually 10 p.c. formalin. After about 20 minutes this was followed by upgraded alcohols. After dehydration the pieces were treated with toluol and then imbedded in paraffin. The sections were stained with hæmalum, carmalum, gentian, safranin and iron-hæmatoxylin, the contrast stains being light green, eosin, acid-fuchsin and picric acid, indigo-carmin and picric acid, and orange G (1 part 1 p.c. solution plus 25 parts 2 p.c. alum-water). For mucus staining, mucicarmin, thionin and toluidin-blue.

Fixation of Nerve-cells.†—Y. Manouélian, in an article on the mechanism of the destruction of nerve-cells, remarks that the Nissl method (fixation with 96 p.c. alcohol), though well suited for the demonstration of the chromophilous particles, causes considerable shrinkage of nerve-cells, and in order to obtain good and reliable preparations, recourse must be had to mixtures of alcohol, formalin, or sublimate with fluids like acetic acid which balance the shrinkage by their property of causing the protoplasm to swell. These fixative mixtures have the further advantage of not being detrimental to staining reagents. The specimens depicted by the author were fixed in Gilson's fluid (alcohol, acetic and sublimate) and stained with magenta and picro-indigo-carmin.

Studying Naididæ.‡ — L. B. Walton made drawings from living specimens with the aid of the camera-lucida. The most satisfactory method was that of transferring the Naid from the culture, by means of a pipette, to a watch-glass, and subsequently to a drop of water on a slide, then placing over the drop a cover-glass, the margin of which was supported by a thin wooden bridge. After a time the specimens, without undue compression, would become quiet, and outline drawings could be made with the camera.

Specimens to be mounted were fixed with hot sublimate-alcohol (sublimate 10 grm., absolute alcohol 100 c.cm., distilled water 100 c.cm., acetic acid 2 c.cm.), stained in borax-carmin, and eventually transferred to balsam, while those sectioned were stained in hæmatin I A (Apáthy), or in iron-hæmatoxylin (Heidenhain), after fixation in cold sublimate-alcohol. The index of refraction of balsam approaches so closely the

* Mit. Zool. Stat. zu Neapel, xvi. (1903) pp. 365–408 (3 pls.).
† Ann. Inst. Pasteur, xx. (1906) pp. 859–68 (1 pl.).
‡ Amer. Naturalist, xl. (1906) pp. 683–706 (12 figs.).

refraction of the transparent setæ, that in order to study them advantageously it was found advisable to kill the specimens by compressing them under the cover-glass, and then at once to make camera-lucida drawings of the setæ in the dorsal and ventral bundles.

Impression Preparations.*—G. Sticker has found that excellent preparations of solid organs can be obtained in the following way. The surface of the tissue or organ is cut smooth with a sharp knife and then a slide is gently pressed down. In this way one or more impressions can be taken on the same slide. As a matter of practice the author advises beginning with lymphatic gland or spleen. The method is not very successful with blood and exudations, or with tough connective tissues. If an organ be very juicy it may be allowed to dry in the air, or treated for a short time with alcohol, formalin, etc. The impression films are best stained by May and Grünwald's† method, or with methylen-blue or carbol-fuchsin.

The author claims that this procedure has many advantages over sections.

Studying the Paraganglia of Birds.‡—W. Kose used the following materials: paraganglion caroticum, paraganglion suprarenale, and sympathetic ganglia. Eleven different fixatives were tried, Müller-formalin giving the best results. The staining reactions of the chromaffin cells, the plasma pigment, the connective tissue, the elastic fibres, were studied by numerous and appropriate methods. Supravital staining with methylen-blue ($\frac{1}{2}$ p.c.) for 1–24 hours, followed by picrate of ammonium for $\frac{1}{2}$–24 hours, was found to show the nerve-fibres very successfully. Digestion experiments were carried out with pancreatin-glycerin and pepsin-glycerin, the former diluted with 0·3 p.c. soda, the latter with 0·3 p.c. HCl. The sections were defatted by means of benzin, and afterwards kept in the digesting fluid at 37°–40° for 24–48 hours.

Technique of Blood Examination in Tropics.§—Sheffield Neave kept his slides in pure lysol, and after a time washed and placed them in boxes ready for use. Any dulling of the surface improved the film. Films from Mammals were easily secured, but with the blood of birds, reptiles and fishes, there was considerable difficulty in obtaining good preparations. The films were treated with Leishman's stain, the slides being placed film downwards in the trough in order to avoid surface deposit. If any deposit occurred it was easily removed by leaving the slide in xylol for $\frac{1}{2}$–2 hours, and then wiping gently with a silk handkerchief, and rinsing again in the trough. The obtaining of useful citrated samples of blood for the purpose of detecting development of parasites was attended with difficulties, one of which is that citrate makes the blood of birds and fishes glutinous and hence more difficult to manipulate, both in the centrifuge and in making films. The system of making thick films and de-hæmoglobinising to detect extra-corpus-

* Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) pp. 206–8.
† See this Journal, 1906, pp. 627–8.
‡ Archiv Mikr. Anat. u. Entwickl., lxix. (1907) pp. 563–663 (3 pls.).
§ Second Report Wellcome Research Lab., Khartoum, 1906, 255 pp., 21 pls. and 106 figs.

cular parasites was unsuccessful with the blood of birds and fishes. The author notes that in films which dry too quickly the red corpuscules become blistered, a condition which also arises in England if artificial heat be used.

Fixation of Spirochæta pallida.* — E. Hoffmann and A. Halle describe an improved method for fixing *Spirochæta pallida*, the details of which are as follows:—5 c.cm. of 1 p.c. osmic acid solution are placed in a watch-glass, and 10 drops of glacial acetic acid added thereto. The watch-glass is placed in a Petri capsule, and clean cover-slips are exposed to the vapour for 2 minutes. Films of the secretion to be examined are then made on these cover-slips in the usual way. The slips are then exposed to the vapour for 1 or 2 minutes. If necessary, the preparation may now be dried in the flame, after which it is placed in a very dilute solution of potassium permanganate for one minute. The film is then washed in water, dried, and stained with Giemsa's solution. The Spirochætes are stained red.

Instead of osmic acid, formalin or pyridin may be used for fixing, but the results are not so good. The authors also mention that fresh, unstained preparations should be used; the secretion should be mixed with normal saline; this method allows the Spirochætes to be observed alive.

Studying the Spermatogenesis of Forficula auricularia.† — H. Zweiger collected the material in the neighbourhood of Jena during July and August. The testicles were removed and fixed in strong Flemming for 1 or 2 days, but a mixture consisting of platinum-chloride, chromic and acetic acids, was specially useful for the mitosoma. For staining, Heidenhain's method, safranin and Gram, fuchsin-methylen-blue, and Cajal's methods, were used.

Studying the Embryo and Larva of Saccocirrus papillocercus.‡ U. Pierantoni collected the material during the 3 months of December to February from the sand in the Gulf of Naples. The mature females were first observed under the Microscope, and if full of eggs were placed in little vessels filled with sea-water. The eggs were always laid in the morning, and were at once fertilised by spermatozoa, which escaped from the spermotheca. Another device for obtaining fertilised ova was to rupture a mature female with needles, and so let out the eggs, which, as in the natural way, were at once fertilised by the zoosperms which escaped at the same time.

Live ova were studied in the fresh state by placing them on a slide in sea-water, and supporting the cover-glass by means of minute fragments of glass. The fixatives used were Rabl's and Perenyi's fluids; after half an hour the eggs were transferred to 70 p.c. alcohol for 3 days, and then stained with Delafield's hæmatoxylin much diluted, or were overstained and afterwards decolorised with hydrochloric-acid alcohol. For sections the same fixatives were used, and also picric acid sublimate. The material was stained *in toto* with Mayer's hæmulum or hæmacalcium.

* Münchener Med. Wochenschr, July 31, 1906. See also Brit. Med. Journ., 1907, i. Epit. 62.
† Jen. Zeitschr. Natur., xlii. (1906) pp. 143–72.
‡ Mitt. Zool. Stat. zu Neapel, xviii. (1906) pp. 47–50.

The paraffin imbedding was carried out in the same vessel as the fixation, etc., in order not to lose any of the eggs, and also to insure the material being on the surface of the block. For the larvæ similar methods were adopted. Picro-carmin was found to give better results than Delafield's hæmatoxylin when the material was stained *en masse*. Creosote was used immediately after the acid-alcohol stage in order to prevent accidental loss of the minutest larvæ. For the camera drawings of the preparations, black copying paper and finely pointed white pencils were used.

(3) Cutting, including Imbedding and Microtomes.

Method of Cutting Frozen Sections of Fresh Tissues for Immediate Microscopic Diagnosis of Tumors during Operations.*—C. B. Lockwood and E. H. Shaw describe the procedure, which may be divided into two parts, as follows.

1. *The Arranging and Fixing-up of the Apparatus required.*—The microtome must be fixed on a firm table, and all the instruments arranged in a convenient manner. A mental survey of the cutting, mounting, and staining of a section is then made, in order to make sure that everything is present and in its proper place. This insures that no time will be wasted when once the process is begun.

2. *Preparation of the Microscopic Section.*—(*a*) The selected piece of tissue received from the surgeon is placed directly on to the brass disk of an ether-freezing microtome, and is surrounded by gum solution. (*b*) The tissue and gum are frozen, and sections made by a razor on a carrier. (*c*) The sections are transferred to a dish of cold water, and, after separating them with a glass rod, a suitable section is lifted out. (*d*) It is dipped for a moment into pure methylated spirit, and (*e*) then placed in another larger dish of cold water; the currents set up by the spirit in the water cause the section to spread out flat. (*f*) A glass slide is dipped in the water under the section, and the latter is lifted out as the slide is slowly drawn up out of the water again. (*g*) The water is drained off the slide, and a drop or two of stain (Loeffler's methylen-blue) is allowed to fall directly on to the section. (*h*) A thin cover-glass is placed on the stain and section after 3–5 seconds; it is lightly pressed down so as to drive out excess of stain; this is then blotted off, and the specimen is ready for examination under the Microscope.

New Form of Microtome-knife.†—E. G. Martin recommends especially for class purposes, the following instrument (fig. 47). Use is made of the safety razor-blades, and the form for which this instrument is adapted is the one which first appeared on the market. The device consists essentially of a stout blade split lengthwise in a plane passing through the cutting edge, and having two parts hinged together at the side away from the cutting edge.

By means of a set-screw the two parts of the blade may be firmly pressed together and held so. The thin blade which is to be used in the actual cutting edge is placed in position between the two parts of the

* Brit. Med. Journ., 1907, i. pp. 127–9.
† Proc. Indiana Acad. Sci. for 1905 (1906) pp. 203–4 (1 fig.).

supporting blade, with its edge slightly projecting, and is firmly clamped there by tightening the set-screw. The instrument is then ready for use. In the illustration the two blades are shown clamped together in position for use, but without the cutting blade inserted. When the set-

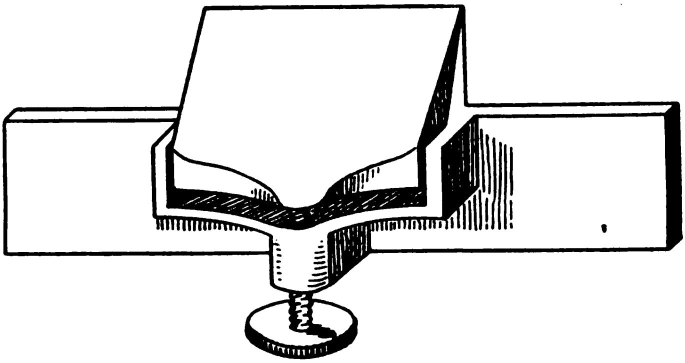

FIG. 47.

screw is loosened the front blade falls forward far enough to allow of the insertion of the cutting blade.

The chief merit of this instrument is that the cutting edge is always satisfactory and sharp; its defect is the shortness of the blade, but for student work the length is found to be ample.

(4) Staining and Injecting.

Staining Spirochæta pallida Schaud.*—Th. Saling, after referring to the work of various authors who have, by means of the silver method, demonstrated the presence of *Spirochætæ* in the tissues and organs of animals and man, states that these spirilla should be regarded as identical with nerve-end fibrillæ.

Demonstrating Negri's Corpuscles.†—Ira van Gieson states that he has found in the following procedure a sure and certain method for examining nervous tissue, especially in reference to the presence of Negri's corpuscles. A piece of grey matter about half the size of a pea is placed upon a slide, and covered with a slip. Gentle pressure is exerted on the slip, and then traction made by drawing the slip slowly along the slide. An excellent preparation, in which many nerve-cells preserve their integrity, is thus obtained.

For the sympathetic nervous system and for the spinal ganglia this method is less suitable, owing to the presence of the connective-tissue element; fair preparations of these parts can, however, be made. Smears produced by the foregoing method may be air-dried or fixed for a few seconds in methyl-alcohol. They are then stained in the following

* Centralbl. Bakt., 1te Abt. Orig., xlii. (1906) p. 120.
† Op. cit., xliii. (1907) pp. 205–6.

solution : saturated alcoholic solution of Rosanilin-violet 2 drops, saturated aqueous solution of methylen-blue 1 drop, distilled water 10 c.cm. The solution must be freshly prepared before use, and for many purposes should be used of double strength. For staining the smears, the solution is allowed to act for 1–2 minutes, and heated until it vaporises. The preparation is then washed with water, dried, and mounted.

Inverse Staining.*—B. Němec gives the following procedure, which is chiefly useful for demonstrating the presence of starch grains. By this method the usual effects of staining reagents is reversed, i.e. the cytoplasm and contents are coloured, while the nucleus and chromosomes remain unstained.

The material was fixed in picric-acetic-sulphuric acid, or with chromic acid, or with Flemming's fluid. It must be noted that osmic acid preparations must be treated with turpentine or peroxide of hydrogen. The sections are transferred from water to 2 p.c. tannin solution for 10–60 minutes. After washing they are placed for 5–15 minutes in 1·5 p.c. tartrate of antimony solution. The sections are then washed in water frequently changed and then are placed in the stain, e.g. aqueous gentian-violet, for half an hour or longer. On removal they are washed for 5 minutes and then passed through upgraded alcohols to absolute, wherein they remain until they no longer give up any dye. When dehydrated (about 5 minutes) the sections are passed through turpentine to xylol and mounted in balsam.

It may be noted that the longer the sections remain in the mordant (tartrate of antimony) the deeper the cytoplasm will be stained. Double stained preparations may be obtained by staining the material *en masse* with paracarmin, or by staining the sections with acid-fuchsin and following this by the inverse method.

Studying the Anatomy of the Kidneys of Gobiesocida.†—F. Guitel adopted the following complicated procedure in his researches on the kidney of *Lepadogaster*, etc.

The animal, having been killed with chloroform, was opened under water along the ventral aspect and the digestive tube removed, care being taken not to injure the kidneys. The body cavity is kept open with a piece of wood and the animal immersed in saturated sublimate, to which 1 p.c. acetic acid is added. After from 2–5 minutes the animal is washed in 70 p.c. alcohol, or in water, and then placed in 70 p.c. alcohol containing 1 per thousand of iodin for 20–60 minutes. The iodin-alcohol solution must be frequently renewed. The kidneys are next removed, but again placed in iodin-alcohol, and afterwards in 90 p.c. alcohol. Arrived at this stage the material may be kept in alcohol for further investigation. Sections of the material were stained with alum-carmin, or with Heidenhain's hæmatoxylin.

Injections of the fixed material prepared as above stated gave fruitful results in the study of the canalicular system. The injection mass used was metagelatin stained with soluble blue. The kidneys to be injected are cut transversely a few millimetres in front of their posterior extremity,

* Ber. Deutsch Bot. Gesell., xxiv. (1906) pp. 528–31.
† Arch. Zool. Expér., v. (1906) pp. 505–608 (5 pls.).

to admit the canula into the lumina of the segmentary canals. The injection is carried out under water, and when over the piece is immersed in 90 p.c. alcohol to set the metagelatin. It is then stained *en masse* with alum-carmin, after which the preparation is carefully stripped of adherent tissues and then cleared up in oil of cloves and mounted in balsam.

By means of Schiefferdecker's corrosion method, casts of the renal cavities were obtained. This method consists in filling the renal canaliculi with celloidin coloured with asphalte, and then dissolving off the tissues with hydrochloric acid.

Soft Injection Mass for Glycerin Preparations.*—C. Skoda finds that hollow viscera, such as intestine, when preserved in glycerin are susceptible of making excellent specimens when injected. The material is immersed in glycerin, to which $\frac{1}{4}$ of a 2 p.c. formal-hydrate solution (1 part commercial formalin and 1 of water). After 6–8 days the specimen is taken out and most of the glycerin removed by squeezing; it is then placed on a dry cloth and rolled up. In this sausage-like state it is placed between two boards, which are either tied together or pressed together by means of a weight. In two days time the specimen is ready for its further treatment. Should the specimen be too dark, it may be bleached for 12–48 hours in $\frac{1}{2}$ p.c. formol solution, to which $\frac{1}{10}$ of a 3 p.c. peroxide of hydrogen solution is added. This bleaching is to be effected before the immersion in the glycerin-formalin mixture.

The injection mass † consists of isinglass, white dextrin, and a pigment, cinnabar for arteries, ultramarine-blue for veins, in the proportion of 2–1, 0·5–1. To this mass, when thoroughly incorporated by rubbing up in a mortar, so much water is added as will impart a honey-like consistence. It may then be injected into the vessels by means of a Teichmann's syringe. The injection is best made under water. The specimen is preserved in glycerin. For further minute details the original should be consulted.

Staining Medullary Sheath of Nerves.‡—W. Stoeltzner communicates the following simple method. The tissue is fixed on formalin and imbedded in celloidin. The section is mordanted for 5 minutes in the officinal liquor ferri sesquichlorati. After a wash in distilled water, it is immersed for at least 10 minutes in 0·5 p.c. aqueous hæmatoxylin solution. The now black stained section is differentiated in Weigert's ferri-cyanide-borax solution or in the iron-chloride mordant mixture.

Injecting the Arteriolæ rectæ of Mammalian Kidney.§—G. C. Huber used a modification of Krassuskaja's injection mass. It was composed of photoxylin 30 grm., camphor 20 grm., aceton 600 c.cm., and was made by adding 0·5 grm. alkanin dissolved in 20 c.cm. aceton to 80 c.cm. of the above described mass. About 10 minutes after injection the organ was cut up into pieces, and these were placed for 24 hours in 75 p.c. hydrochloric acid in which the tissues are so macerated that they may be readily washed away with water, leaving a cast of the blood

* Anat. Anzeig., xxix. (1906) pp. 602–5 (3 figs.).
† See this Journal, 1906, p. 739.
‡ Zeitschr. wiss. Mikrosk., xxiii. (1906) p. 329.
§ Brit. Med. Journ., 1906, ii. p. 1700.

vessels. They may be studied in water or mounted in balsam. The author examined his preparations under a Zeiss binocular stereopticon Microscope.

Studying Phagocytoses in Frogs and Insects.*—L. Mercier, when studying the phagocytic processes during the metamorphosis of Batrachia and insects, adopted the following procedure. Sterilised powdered carmin was injected into the dorsal lymphatic sac of four adult frogs. Next day pieces were cut off the tail of young tadpoles still devoid of feet, and these pieces were introduced into the lymphatic sacs of the frogs which on the previous day had received the carmin injection. On the third, fifth, sixth and eighth subsequent days the frogs were killed; lymph was removed from the sacs by means of a pipette, placed on a slide, and fixed by heat. The films were stained with hæmatoxylin and eosin. The fragments of the tails found in the sacs were fixed in sublimate, and the paraffin sections made therefrom were stained with iron-hæmatoxylin and eosin. The technique used in the case of the Muscidæ was on similar lines to that used for the frogs. The insects in the nymph stage were injected with the carmin solution by means of a very fine glass tube. The larvæ were first fixed by immersion in water at 72°; the animals were then cut open either longitudinally or transversely, and placed in sublimate or in Bouin's or Flemming's fluid.

Injecting Liver.†—P. T. Herring and S. Simpson, for their study of the relation of the liver-cells to the blood-vessels and lymphatics, used a carmin-gelatin mass made according to Carter's formula. The solutions of gelatin and ammoniacal carmin were filtered separately and very carefully, then mixed and rendered slightly but distinctly acid with acetic acid. During the operation the injecting apparatus was kept immersed in warm water. The pressure was indicated by means of a mercury manometer. The cannula was inserted in the aorta or the portal vein. In the former case the inferior vena cava was opened above the diaphragm, and in the latter the inferior cava was ligatured below the liver. A preliminary washing out of the blood-vessels with physiological saline was found to be unnecessary. The pressure employed varied from 60–160 mm. of mercury, when the injection was made through the aorta, and rarely exceeded 20 mm. of Hg when made from the portal vein.

When injection was completed, the liver was removed if the animal was large; if small, the abdomen and thorax were freely opened, and the whole animal placed at once in 10 p.c. formalin, with some ice added. When the gelatin had set the liver was removed and cut into pieces, and put back into 10 p.c. formalin. When thoroughly fixed the pieces were dehydrated and paraffin sections made. These were lightly stained with hæmatoxylin. Deep staining stains the gelatin and masks the carmin.

(5) Mounting, including Slides, Preservative Fluids, &c.

New Dehydrating Apparatus.‡—A Greil describes an apparatus suitable for dehydrating delicate embryological and histological material.

* Archiv Zool. Expér., v. (1906) pp. 1-151 (4 pls.).
† Proc. Roy. Soc., Series B, lxxviii. (1906) pp. 455–97 (2 pls.).
‡ Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 286–301 (4 figs.).

It consists of two parts, the glass apparatus for dehydrating and a metal frame, which is in connection with a motor apparatus. The latter imparts an oscillating movement to the dehydrator, so that currents are set up whereby the fluids become more rapidly and intimately mixed. The motor apparatus can also be used as a shaker for decalcification, for emulsifying, for photographic work, or for driving a microtome.

The dehydrator proper (fig. 48) consists of an upper bulbous glass receptacle, terminating below in a tube, the extremity of which dips into a glass reservoir intended for the reception of the sections and specimens to be dehydrated. The bulb is closed above by a glass stopper, with a bore for the purpose of admitting air, and for regulating the pressure inside the bulb. The reservoir is supplied with a doubly bent syphon for carrying off superfluous fluid into the lowermost receptacle. The neck of the tube from the bulb is stuffed with dry copper-sulphate and also with cotton or glass wool.

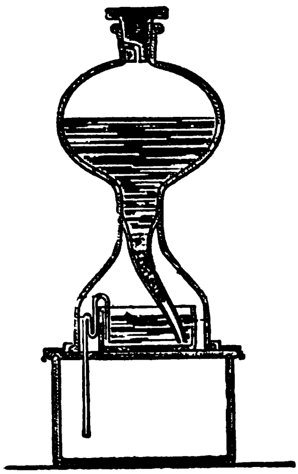

FIG. 48.

Apparatus for Washing Sections.*—A. Frazer has devised an apparatus which consists of a shallow metal trough about 3 in. deep and 4 in. square. Within it are placed four wide test-tubes, into the lower parts of which a number of small holes are made. The trough is furnished with several wires placed crosswise: these keep the test tubes apart and in a vertical position. The various sections to be washed are placed in the tubes, and water is allowed to circulate in the trough. The holes in the tubes are large enough to allow the water to circulate freely, but small enough to prevent the sections from passing out. The apparatus can, of course, be constructed to contain any number of tubes.

Aceton in Microscopical Technique.†—G. Marpmann describes some of the properties of aceton and its uses in microscopical technique. It is miscible with water, alcohol, and other fluids, and a good solvent of most substances except proteids. It can be used as a preservative for animal and vegetable specimens. A mixture of 1 part of aceton and 9 parts of water is extremely serviceable for keeping green or blue algæ. For animal preparations, aceton 1 part, glycerin 3 parts, and water 6 parts, is recommended. As a fixative, aceton 50 parts, water 50 parts, sublimate 1 part, may be used. In this mixture the preparations remain for two or more days according to size, and are afterwards transferred to pure aceton, repeatedly changed. They are then imbedded in celluloid solution or in a solution of pyroxylin 1 part, camphor 1 part, aceton 8 parts. This medium is quite as suitable for section purposes as celloidin.

* Proc. Scot. Micr. Soc., iv. (1906) p. 68.
† Zeitschr. angew. Mikrosk., xii. (1906) pp. 157–61.

For staining purposes, alcoholic solutions of pigments or the dry pigments may be dissolved in aceton.

For mounting purposes, solutions of mastix, balsam, styrax, may be dissolved in aceton, and make serviceable preparations. Celluloid solution dissolved in aceton, and rubbed up with cinnabar, chromoxide, ultramarine, or zinc white, makes an excellent lac or cement for ringing round preparations, etc. This celluloid cement may be used for multifarious purposes in the laboratory, e.g. for stopping gas-leaks, sealing corks, mending broken apparatus, and so on.

The addition of a little amylacetate imparts a greater elasticity to the cement. If gum-soaked preparations be exposed to the action of aceton vapour before cutting, they are more easily sectioned. Aceton, like alcohol, ether, and benzin, is inflammable.

(6) Miscellaneous.

Barberio's Spermatic Reaction.*—J. B. Levinson calls attention to this reaction, which is described as follows. Spermatic fluid or a concentrated solution of it is added to saturated solution, aqueous or alcoholic, of picric acid. Needle-shaped rhombic crystals of a yellow colour, like Charcot crystals in shape, are formed.

Metallography, etc.

Copper Steels.†—P. Breuil states that in steels containing carbon 0·56–0·79 p.c., copper 0·5–20 p.c., the point Ar 1 occurs between 575° and 600° C. In alloys with 3 p.c. or more copper, a separation of copper or of an iron-copper alloy occurs, and a critical point is found at about 1000° C. A number of tensile test results given by the author show that copper increases the tenacity and lowers the ductility of the steel, the extent of this effect varying with the treatment to which the steel is subjected.

A Method of Measuring the Resistance of Metals to Rapid Deformation.‡—P. Vieille and R. Liouville, by simultaneously compressing two identical copper crushers, separated by a light steel piston, by ballistic pressure developed by an explosive, have shown that the inertia forces are negligible. The displacements of the piston receiving the pressure of the gases, and of the piston separating the two crushers, are recorded on a revolving drum. The ordinates of the first curve are double those of the second. If now the second crusher has been previously submitted to a given static pressure, it commences to deform when that pressure is reached. This point is sharply indicated as the origin of the time-compression curve of the previously compressed cylinder. From the two curves, the compression of the new crusher, the velocity of compression, and the actual pressure at this point are obtained. The authors show that the amount of compression for a given

* Berlin Klin. Wochenschr, Oct. 8, 1906. See also Brit. Med. Journ., 1907, i. Epit. 32.
† Comptes Rendus, cxliii. (1906) pp. 346–8.
‡ Tom. cit., pp. 1218–1221. See also this Journal, 1906, p. 514.

pressure is different according as the pressure is applied statically or ballistically. The difference may amount to about 8 p.c.

Relation between Breaking Stress and Extension in Tensile Tests of Steel.*—In this paper "breaking stress" is used to mean maximum tension per unit of area of original cross-section of test-piece, and "intrinsic strength" to mean actual intensity of the stress at the broken surface. It has been observed that for test pieces a few diameters in length, the sum of breaking stress (in tons per square inch) and elongation per cent. is very nearly a constant, equal to 67–68, for mild steels free from internal mechanical strain. A. Mallock shows mathematically that this follows from the assumption that the intrinsic strength of a material is a quantity which is not altered by heat treatment. The intrinsic strength of all ordinary steels (excluding cold-worked material) appears to be about 70 tons per square inch.

The Art of Cutting Metals.†—A section of this technical engineering paper by F. W. Taylor, is devoted to an elementary discussion of the micro-constitution and theory of hardening of tool steels. The author criticises Carpenter's explanation of the characteristic properties of high speed steels, and expresses the opinion that no satisfactory explanation of "red-hardness"—i.e. the quality of maintaining a cutting edge at a red heat—has yet been advanced.

Crystallography of Iron.‡—Though it has been shown that the three allotropic states of iron all crystallise in the cubic system, it would appear probable that differences in their intimate structure exist. F. Osmond and G. Cartaud here describe the experimental methods they have adopted, and the results obtained in the further study of this subject. Characters capable of yielding information are:—(1) deformation figures, including lines of translation and mechanical twinning; (2) congenital twinning; (3) twinning resulting from annealing after deformation; (4) mechanical properties functional of the crystalline orientation; (5) corrosion figures; (6) synchronous crystallisation figures; (7) segregation figures. For work on α and β iron, the specimens used were very coarsely crystalline fragments of iron, from which single crystals could be cut. At ordinary temperatures these were α iron, at 800° C. β iron. For γ iron, samples of manganese steel and nickel steel were used at ordinary temperatures, the size of the crystals being as large as could be obtained. The authors found that the three modifications exhibited important differences in crystalline characteristics, and embody their results in a table. They suggest, as a possible interpretation, that in the α state the mesh is a simple cube, while the mesh of β iron is a centred cube, and that of γ iron a cube with centred faces. The authors, however, consider attempts at interpretation to be premature.

Constitution of Iron-Carbon Alloys.§—A. Sauveur discusses the Roozeboom diagram. The eutectic forming at about 1130° C., and

* Proc. Roy. Soc., Series A, lxxviii. (1907) pp. 472–8 (5 figs.).
† Proc. Amer. Soc. Mech. Eng., xxviii. (1906) pp. 1–248 (154 figs.).
‡ Journ. Iron and Steel Inst., lxxi. (1906) pp. 444–92 (37 figs.).
§ Op. cit., lxxii. (1906) pp. 493–575 (12 figs.).

containing about 4·2 p.c. carbon, is accepted as an austenite-graphite eutectic. The author regards graphite once formed as taking no part in subsequent changes, and explains the horizontal at 1000° as indicating separation of cementite from austenite. Some very pure iron-carbon alloys were prepared and treated in ways calculated to favour the supposed formation of cementite from iron + graphite at 1000°. In each case the alloy was found to contain more graphite than could be formed during solidification, indicating that not only had cementite not been formed from graphite in the cooling after solidification, but that cementite had decomposed, yielding graphite. The author makes some suggestions as to the constitution of austenite, martensite, and troostite. Among the contributors to a lengthy and valuable discussion on this paper were C. Benedicks, H. le Chatelier, H. M. Howe, Jüptner von Jonstorff, A. Stansfield, J. E. Stead, and F. Wüst.

Heat Treatment of Steels containing 0·5 and 0·8 p.c. Carbon.* C. E. Corson has investigated the effect on structure and physical properties of (1) heating to varying temperatures followed by cooling at a constant rate; (2) heating to a given temperature followed by cooling at varying rate; (3) varying the finishing temperature in forging, and also the rate of subsequent cooling. The author's results agree with the generally accepted theories of heat treatment.

Effect of Low Temperature on the Recovery of Steel from Overstrain.†—It is known that steel recovers from overstrain at ordinary temperatures, and that this recovery is hastened by raising the temperature. E. J. McCaustland has shown that the effect of continued low temperature (below 0° C.) on a piece of steel which has been stretched slightly beyond the elastic limit, is to arrest completely the recovery of its elastic properties. The author also studied the progress of recovery at about 20° C., and at the temperature of a steam bath, in steel which had been overstrained and then maintained at a low temperature for some time.

Structure of Metals.‡—A report of a lecture by J. A. Ewing. The crystal granules are regarded as built up of polarised molecules, crystalline orientation depending on their polar quality. An explanation of the phenomena of strain and fatigue, consistent with this theory of the structure of the crystal, is given.

Equilibrium and Solidification Structures of the Iron-Carbon System.§—In this paper on the much-discussed iron-carbon system, C. Benedicks critically reviews at some length the experimental results hitherto obtained, and the theories founded on them. He considers that it has been proved that cementite is endothermic and metastable, and that the reaction, mixed crystals + graphite = cementite, cannot occur. Roozeboom's equilibrium diagram is accordingly simplified by the omission of the horizontal line at about 1000° C. Iron-graphite is

* Journ. Iron and Steel Inst., lxxi. (1906) pp. 603–7 (abstract).
† Tom. cit., pp. 616–21 (abstract).
‡ English Mechanic, lxxxv. (1907) p. 58.
§ Metallurgie, iii. (1906) pp. 393–5, 425–41, 466–76 (36 figs.).

held to be the stable system resulting upon extremely slow cooling, while iron-cementite is the metastable system obtained by more rapid cooling. The eutectic point for the latter occurs at 4·2 p.c. carbon. Transition from the metastable to the stable system takes place upon annealing at a suitable temperature. Graphite may be formed directly from the melt during solidification. The decomposition of cementite is catalytically accelerated by silicon. The author examined microscopically a number of pig-irons of different carbon content: his photomicrographs support the above conclusions. An explanation, consistent with the theory of equilibrium, of the possibility of cementing iron to a high percentage of carbon by heating in contact with carbon, is given. A useful feature of the paper is the bibliography appended.

Heat Treatment of High Carbon Steels.*—W. Campbell has investigated the effect of heating to different temperatures, followed by slow cooling, on the mechanical properties and microstructure of six steels containing 0·7–2 p.c. carbon. The temperatures ranged from 650°–1200° C.; the initial condition of the bars appears to have been as forged to a small section. The tendency of cementite to assume a globular form is noted. When a sufficiently high temperature is reached (1000°–1200° C.), cementite remaining undissolved decomposes into ferrite + graphite. Generally tenacity was found to diminish and ductility to increase with increase of temperature of reheating up to Ac 1. Little further change occurred until much higher temperatures were reached, when overheating effects were apparent.

Constitution of the Copper-Tin Alloys.†—E. S. Shepherd and E. Blough have made a careful revision of the concentration-temperature diagram. The composition of the solid phases was determined by the analytical method of Bancroft, lead being used as the third component. Heycock and Neville's diagram was considerably modified in certain regions. The chief results are (1) the phases which can co-exist with the melt are the α, β, and γ solid solutions, the compound Cu_3Sn, the ϵ solid solution, and pure tin; (2) below 600° C. the δ solid solution, previously supposed to be Cu_4Sn, can exist. The authors indicate the great importance of the time factor in establishing equilibrium relations, and the impossibility of constructing diagrams solely from pyrometric data.

Photographs, showing the structures characteristic of each region, will be given in a later paper.

Influence of Chromium on the Solubility of Carbon in Iron, and on Graphite Formation.‡—P. Goerens and A. Stadeler regard it as proved that in iron-chromium-carbon alloys part of the chromium exists as a double carbide of iron and chromium, the rest being present in solid solution in the iron. The authors have prepared a series of alloys saturated with carbon at 1600° C., and have determined carbon content and taken cooling curves. With increasing chromium content, more carbon is required for saturation, the alloy with 62 p.c. chromium containing 9·2 p.c. carbon. The alloys with 0–10·4 p.c chromium have a

* Journ. Amer. Chem. Soc., xxviii. (1906) pp. 1304–22 (29 figs.).
† Journ. Phys. Chem, x. (1906) pp. 630–53 (6 figs.).
‡ Metallurgie, iv. (1907) pp. 18–24 (17 figs.).

solidification point practically the same as the eutectic freezing-point for pure iron-carbon alloys, 1130° C. With still further increase of chromium the freezing-point rises, and with 62 p.c. chromium it is 1535° C. A lower critical point at about 710° C. was found in all the alloys containing not more than 21 p.c. chromium. The failure of silicon additions to cause graphite separation demonstrated the powerful influence of chromium in preventing formation of graphite.

ALLEN, H. S.—**The Photoelectric Fatigue of Zinc.**
Proc. Roy. Soc., Series A, lxxviii. (1907) pp. 483–93 (4 figs.).

BENEDICKS, C.—**Acetate Copper (so-called Allotropic Copper).**
Metallurgie, iv. (1907) pp. 5–17, 33–44 (26 figs.).

BRAUNE, H.—**Importance of Nitrogen in Iron.**
Stahl und Eisen, xxvi. (1906) pp. 1357–63, 1431–7, 1496–9 (21 figs.).

CARPENTER, H. C. H.—**Tempering and Cutting Tests of High Speed Steels.**
Journ. Iron and Steel. Inst., lxxi. (1906) pp. 377–96 (25 figs.).

CHIKASHIGÉ, M.—**Bismuth-thallium Alloys.**
Zeitschr. Anorg. Chem., li. (1906) pp. 328–35 (2 figs.).

DOERINCKEL, F.—**Compounds of Manganese and Silicon.**
Op. cit., l. (1906) p. 117–26 (7 figs.).

GRUBE, G.—**Alloys of Magnesium with Cadmium, Zinc, Bismuth, and Antimony.**
Op. cit., xlix. (1906) pp. 72–92 (12 figs.).

GUERTLER, W.—**Electrical Conductivity of Alloys.**
Op. cit., li. (1906) pp. 397–433 (21 figs.).

GUERTLER, W., & G. TAMMANN—**Silicides of Nickel.**
Op. cit., xlix. (1906) pp. 93–112 (15 figs.).

„ „ „ **Copper-nickel Alloys.**
Op. cit., lii. (1907) pp. 25–9 (7 figs.).

GWYER, A. G. C.—**Aluminium-bismuth and Aluminium-tin Alloys.**
Op. cit., xlix. (1906) pp 311–19 (2 figs.).

HEYN, E.—**Metallographic Research in Foundry Practice.**
Stahl und Eisen, xxvi. (1906) pp. 1386–93 (18 figs.).

HEYN, E., & O. BAUER—**Copper and Phosphorus.**
Zeitschr. Anorg. Chem., lii. (1907) pp. 129–51 (30 figs.).

HIBBARD, H. D.—**Internal Stresses and Strains in Iron and Steel.**
Journ. Iron and Steel Inst., lxxii. (1906) pp. 608–15.

LOSSEW. K.—**Alloys of Nickel and Antimony.**
Zeitschr. Anorg. Chem., xlix. (1906) pp. 58–71 (13 figs.).

MATHEWSON, C. H.—**Sodium-lead, Sodium-cadmium, Sodium-bismuth, and Sodium-antimony Alloys.** *Op. cit.*, l. (1906) pp. 171–98 (4 figs.).

PETRENKO, G. I.—**Alloys of Silver with Thallium, Bismuth, and Antimony.**
Tom. cit., pp. 133–44 (7 figs.).

PÜTZ, P.—**Influence of Vanadium on Iron and Steel.**
[This portion contains the results of the author's investigations on micro-structure.] *Metallurgie*, iii. (1906) pp. 714–21 (48 figs.).

RUER, R.—**Alloys of Palladium with Copper.**
Zeitschr. Anorg. Chem., li. (1906) pp. 223–30 (7 figs.).

„ **Alloys of Palladium with Silver.**
Tom. cit., pp. 315–19 (7 figs.).

„ **Alloys of Palladium with Gold.** *Tom. cit.*, pp. 391–6 (7 figs.).

SAHMEN, R.—**Copper-cadmium Alloys.** *Op. cit.*, xlix. (1906) pp. 301-10 (5 figs.).

SAUVEUR, A.—**Metallography applied to Foundry Work.**
Foundry, xxix. (1907) pp. 320-4 (7 figs.).

TREITSCHKE, W.—**Antimony-cadmium Alloys.**
Zeitschr. Anorg. Chem., l. (1906) pp. 217-25 (2 figs.).

TREITSCHKE, W., & G. TAMMANN—**Equilibrium Diagram of Iron and Sulphur.**
Op. cit., xlix. (1906) pp. 320-35 (6 figs.).

v. VEGESACK, A.—**Zinc-thallium and Zinc-iron Alloys.**
Op. cit., lii. (1907) pp. 30-40 (7 figs.).

VOGEL, R.—**Alloys of Gold with Bismuth and Antimony.**
Op. cit., l. (1906) pp. 145-57 (8 figs.).

WEDDING, H.—**Copper in Iron.** *Stahl und Eisen*, xxvi. (1906) pp. 1444-7 (6 figs.); see also pp. 1493-5 (2 figs.).

„ „ **Nickel Iron.** *Op. cit.*, xxvii. (1907) pp. 195-7.

WILLIAMS, R. S.—**Antimony-thallium Alloys.**
Zeitschr. Anorg. Chem., l. (1906) pp. 127-32 (1 fig.).

WÜST, F.—**Contribution to the Theory of Graphite Formation.**
Metallurgie, iii. (1906) pp. 757-60 (10 figs.).

„ **Mechanical Properties and Composition of Malleable Castings.**
Op. cit., iv. (1907) pp. 45-53 (5 figs.).

WÜST, F., & O. PETERSEN—**Influence of Silicon on the Iron-carbon System.**
Op. cit., iii. (1906) pp. 811-20 (15 figs.).

ZEMCZUZNYJ, S. F.—**Zinc-antimony Alloys.**
Zeitschr. Anorg. Chem., xlix. (1906) pp. 384-99 (14 figs.).

„ „ **Alloys of Magnesium with Silver.**
Tom. cit., pp. 400-14 (11 figs.).

A Case of Malleability of Grey Cast Iron.
Metallurgie, iii. (1906) pp. 786-7 (2 figs.).

Properties of Alloys. *Nature*, lxxv. (1907) pp. 426-7.

The Commercial Value of the Microscopic Examination of Metals.
English Mechanic, lxxxiv. (1907) pp. 612-13.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 20TH OF FEBRUARY, 1907, AT 20 HANOVER SQUARE, W.
THE RIGHT HON. LORD AVEBURY, P.C., F.R.S., PRESIDENT,
IN THE CHAIR.

The President said that before asking the Secretary to read the Minutes, he should like to express his thanks to the Fellows of the Society for the great honour they had conferred upon him by electing him the President of this very important Society, of which he had himself been a Fellow for many years, although from the pressure of other engagements, he had not been able to attend the Meetings so often as he could have wished, and he could assure them that he should endeavour to do whatever he could to advance the prosperity of the Society.

The Minutes of the Meeting of the 16th of January, 1907, were read and confirmed, and were signed by the President.

The Secretary announced that Mr. Hilton had sent a quantity of material consisting of Polycistinæ from Springfield for distribution; also that some diatomaceous earth from Dunrobin had been sent by Mr. Earl for the same purpose. Fellows desiring to have any of this were asked to make application for it to Mr. Parsons.

The List of Donations to the Library, exclusive of exchanges and reprints, received since the last Meeting, was read as follows :—

	From
Andrew Balfour, Second Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum. (8vo, Khartoum, 1906)	*The Director of the Laboratories.*
Alfred C. Chapman and F. G. S. Baker, An Atlas of the Saccharomycetes. (4to, London, 1906)	*The Authors.*
Abraham Flatters, The Cotton Plant. (8vo, London, 1906)	*The Author.*
W. A. Herdman, Ceylon Pearl Oyster Fisheries and Marine Biology. Report to the Government of Ceylon. Part V. (4to, London, 1906)	*The Royal Society.*
The Franklin Bicentennial Celebration, Philadelphia, 1906. (8vo, Philadelphia, 1906)	*The American Philosophical Society.*
Recueil de l'Institut Botanique. Tome II. (Brussels, 1906)	*The Director of the Institute.*
Cours Pratique de Microchemie Végétale. By Léo Errara	
Powell and Lealand No. 2 Stand (1885), and accessories	*Mr. Peyton T. B. Beale*
Powell and Lealand No. 3 Stand (1848), and accessories	
Hugh Powell Tank Microscope, and accessories	
W. J. Salmon, Stand with eye-piece, etc.	
W. Matthews, Stand with eye-piece	
Powell and Lealand, Portions of a Goniometer	
S. Highley, five Low-power Objectives	
Miscellaneous apparatus	

On the motion of the President, the thanks of the Society were unanimously voted to the donors.

Mr. J. W. Gordon read a paper entitled "An Early Criticism of the Abbe Theory," written in answer to a paper by Mr. Conrady with the same title, read before the Society on October 17, 1906, and printed in the Journal of December, 1906, pp. 645 to 647. At the conclusion of his paper Mr. Gordon exhibited some photographs of the spectrum produced by the fine ruling of an Abbe Diffractionsplatte, and showed thereby that as the radius of curvature of the incident wave-fronts was reduced from 0·011 in. to 0·008 in. and 0·004 in. successively, the spectrum became more and more compressed as if the grating interval were becoming larger. When the radius of curvature was reduced to 0·002 in. the spectrum of the grating disappeared, giving place to the spectrum due to a single opening of the grating, and when the source of light was focused in the same plane as the grating, the spectrum disappeared altogether. Only one or two lines of the grating were at all illuminated by the direct light, but a finely resolved image of the grating was shown lighted up by the diffused light irregularly reflected from the lens and other internal surfaces of the instrument.

Mr. Conrady, in reply, said: Mr. Gordon suggests that he should have been made aware of the fact that my note was being sent in. Seeing that, owing to its nature, Mr. Gordon could not possibly have replied to it without having first carefully studied Dr. Altmann's paper, and that I wrote the note only the evening before it was read, I do not see much force in his argument. On the contrary, he should be grateful that I have thus given him a full month in which to prepare a reply, with the added advantage that he will have the last word on the subject to-night.*

The issue concerning Mr. Gordon which I raised in my note is clearly stated in the last paragraph but one, in the words:

"For this Society there is a further interest in Altmann's paper, inasmuch as it obviously represents a singularly complete anticipation of a paper read before it more than twenty years later by Mr. J. W. Gordon. Altmann's modified diffusion disks are completely identical with Mr. Gordon's antipoints, and it will be noted that even the arguments employed are very similar in many cases."

One would think that if Mr. Gordon intended to dispute this statement, he would first have carefully studied the paper by Dr. Altmann, and, supposing the result to be encouraging, would have stated, with all the clearness of which he is so capable, in what respect his antipoints differ from Altmann's diffusion disks, and what essentially new points he —Mr. Gordon—had brought forward in his paper of 1901.

Now the supposed reply just read clearly states the remarkable fact that Mr. Gordon has not read Dr. Altmann's paper; it cannot therefore show in what respect Mr. Gordon's paper marked an advance on Dr. Altmann's, and it does not, as a matter of fact, deal with a single one of the clear points of similarity which I mentioned. Mr. Gordon prefers to discuss side issues which really do not affect the case under discussion. He clings to the fact that Dr. Altmann knew and referred

* Mr. Conrady has omitted to allude to the advantage he obtained from an advance copy of the paper, forwarded to him, with Mr. Gordon's accustomed courtesy, a full week before the February Meeting.—Ed.

to Helmholtz's work on the diffusion disk whilst he himself was unaware of it, and founded his antipoint theory on the earlier work of Airy. But I did not discuss at all the question as to the source of the two authors' knowledge: I merely pointed out that the conclusion they came to was exactly the same, viz. that the spurious disk theory might be extended to the Microscope by taking into account the modification which the spurious disk undergoes owing to the peculiar modes of lighting microscopical objects. This extension, if proved sound, would be a distinct addition to the astronomical theory of the spurious disk, and would thus justify a claim of originality on the part of both Dr. Altmann and Mr. Gordon, and I do not doubt that hitherto everybody has considered his suggestions for an antipoint theory of the Microscope as Mr. Gordon's principal scientific achievement.

I cannot see anything in my paper which could be interpreted as aiming at the extension of my somewhat curt reference to the "smiles and sneers" of Dr. Altmann for the Abbe theory to Mr. Gordon's treatment of the same doctrine. Still, personally, I would rather put up with smiles and even with sneers than be accused of such extraordinary elementary blunders as those which Mr. Gordon attributed to Professor Abbe.

Mr. Gordon deals very extensively with the aerial image of a grating, and states, on the whole correctly, the views on the subject which follow from the undulatory theory as usually interpreted, and which were implicitly believed until about ten years ago. This belief was then rudely shattered by a crucial experiment which Dr. Johnstone Stoney, F.R.S., showed at the Royal Society, and which I am showing here to-night. This experiment proves conclusively that under the conditions prevailing in the Microscope the flame image behaves exactly as if it consisted of diffused light; the diffraction-spectra refuse to vanish, no matter how carefully the condenser may be focused and adjusted.* I have, indeed, gone to the length of using an apochromatic objective as a condenser—an experiment which I showed when reading my first paper on microscopical theories: still the diffraction spectra will not vanish.

When a crucial experiment of this kind disagrees so obviously with theory, the latter has to be modified; the last word has not yet been spoken on this point, and I therefore prefer to leave the theoretical aspect undiscussed. But there can be no doubt whatever that the diffraction-spectra cannot be got rid of by using critical light.

* The experiment shown by me accurately represented the Microscope in its normal working condition; the focusing of the lamp-flame was therefore imperfect for the reason which I fully explained in my first paper on Microscopical Theories (see this Journal, 1904, p. 612). On applying the calculation there first exemplified to the present case, I find that the diffusion of focus of the foremost and rearmost portions of the flame employed would cause diffused light reaching in maximo over about four adjoining slits when the edge of the flame was employed, but so slight as not to bridge even two adjoining slits when, as was usually the case, the broad side of the flame was presented to the condenser. Even in the first case the diffraction-spectra should have been considerably modified, whilst in the second case they should have vanished. As all those present saw, they refused to vanish in every case. In fact, in the paper already cited, on p. 631, I also mentioned that no matter how delicately the experiment may be carried out, the diffraction-spectra can only be got rid of by illuminating only one single slit; but no one would or could expect grating-spectra from a single slit,

The reason why Mr. Gordon obtained an apparently opposite result in an experiment which he showed on two occasions is probably that his experiment did not comply with the conditions usually prevailing in the use of the Microscope, and that it also did not enable one to separate the effect of a change of focus from the disturbing effect of a simultaneous change in the angle of the illuminating cone. Such mixed effects are quite inadmissible as evidence in scientific investigations. In Dr. Stoney's experiment this mixing of different effects and departure from normal conditions is carefully avoided by using the ordinary equipment of the standard Microscope, thus enabling one to study the effects of change of focus independently from changes of angle of cone and changes of illuminated area.

The same reproach of being behind the times applies to Mr. Gordon's last statement: "The Abbe theory takes account of 'diffraction' wherever it occurs." It first notes that which takes place in the object; it then closely watches the passage of all the light through the objective, and notes whether all of it is admitted or whether part of it is cut off, considering only that which is admitted. But whatever may be the condition of the light entering an optical instrument, the only function of the limiting aperture is to determine the area through which light can enter, and as the Abbe theory necessarily considers this limiting effect of the aperture, it takes "apertural diffraction" into full account.

The idea that diffraction took place only at the sharp edge of the limiting aperture is a hopelessly antiquated one. The final image is always due to the interference of all the light which enters into an optical instrument, no matter whether that light has come uninterruptedly from a self-luminous object, or whether a greater or lesser part of it is due to a preliminary "diffraction" in an artificially-lighted object.

Mr. Rheinberg said that those interested in the subject knew that Mr. Gordon was one of the few who regarded Abbe's epoch-making work on the theory of image-formation in the Microscope as incorrect.

So far as the objections mentioned that evening were concerned, he thought these had all been brought forward by Mr. Gordon years ago, when they were fully dealt with in discussion, and to his mind, amply disproved. He agreed with Mr. Conrady that the matter turned on the question of diffraction by the object, which Mr. Gordon thought he had disposed of when the objective was filled with light. But this was fallacious—though masked, it was present and effective all the time.

Regarding the question of "apertural" diffraction, it was quite a mistake to suppose that this had not been taken into account by Abbe—he could say this from discussions on the subject with those who were intimately associated with the latter—and it might also, he thought, be found in Abbe's papers. As a rule, however, the diffraction by the object played a role so much more important than that due to the diffraction by the aperture of the objective, and it became unnecessary to lay much stress on the latter.

Mr. Gordon said that he would not follow Messrs. Conrady and Rheinberg on the personal points which they had raised, since that

could only lead to barren contradiction. There was therefore only one matter for him to deal with, namely Mr. Conrady's experiment exhibited that evening, with the object of showing that however he illuminated his grating he could not get rid of the spectra. He pointed out that Mr. Conrady's apparatus was not properly set up for testing this point. Fellows would have observed in his photographs that he (Mr. Gordon) did not start observing the spectra until the source of light had been brought within about $\frac{1}{100}$ in. of the grating, and the spectrum did not change to the spectrum of a single opening until the source of light was brought to within $\frac{1}{500}$ in. of the grating. Now Mr. Conrady's source of light was a lamp flame arranged "end on" in front of the condenser, and it was impossible to place an image of such an object at $\frac{1}{500}$ in. from the grating, for the image would have a greater depth than that measured along the optical axis, and when one edge of it was actually in the grating the other edge would be far enough away to give visible spectra in the tube of the instrument. It was impossible to draw any inferences at all from such an experiment. Mr. Gordon on the contrary had availed himself of the slit which Professor Abbe himself prescribed as the source of light in these Abbe experiments, and so obtained what might be termed a film source of light which could be placed with great precision in any determined position. That was why he had succeeded where Mr. Conrady had failed.

The Secretary said they had two other papers on the agenda for the evening, one by Mr. James Murray, "On some Tardigrada from the Sikkim Himalaya," and the other by Dr. Eugène Penard, "On some Rhizopods from the Sikkim Himalaya." Mr. Rousselet, who had been unfortunately taken suddenly ill, was to have communicated these papers, but in his absence, as they consisted largely of descriptions of species, it was decided to take these papers as read. Mr. Penard's paper described what had been found in the district named, at about 3000 ft. above sea level, whilst Mr. Murray's paper gave a description of a number of species of Tardigrada found chiefly in moss from the same region, and concluded with a list of the literature of the subject.

The President said that papers of this kind were no doubt extremely useful as additions to zoological knowledge of these organisms, but they did not usually lend themselves to much discussion.

The thanks of the Society were unanimously voted to the authors of the several papers.

Dr. Hebb said he had received a letter from Mr. E. M. Nelson which was an appendix to his paper on the flagella of the tubercle bacillus :—

"There was a young doctor (Cambridge) here who wanted to see the flagella of tubercle. So we went at it, and he could make nothing of it at all. I then got him to put down his pipe, and kept him in a darkened room for a couple of hours. After this he began to see something, and as time went on he saw them more readily. After a little he was able to see them without difficulty, and then took to finding fresh examples all over the slide. I inclose some sketches he made. I am

sending you this because this man knew nothing of Microscope work beyond what he had done in the medical schools, and, what is more important, he has not what may be called good sight for instrumental work. He is so troubled with muscæ that only the lowest power eye-pieces can be used.

"This case proves the ease with which the flagella (or whatever these appendages of the tubercle bacillus are) can be seen."

Dr. Hebb also read an abstract from a letter from Major Sampson, describing an observation made in Southern Nigeria, as follows: "A curious case came under my notice the other day (I have not seen it in any book). A thick living arch of travelling ants across a sunny road, and in the centre hundreds of pupæ being carried along in the shade thus caused!! This is the more wonderful because the African ant, as a rule, cannot stand the sun at all."

The President said no doubt many of those who were present had seen the very beautiful slides which had been sent up by Mr. Flatters for exhibition that evening—some of which were exceptionally good. He was sure they would all unite in passing a very hearty vote of thanks to Mr. Flatters for his kindness, and would also give their thanks to Messrs. Beck for the loan of the Microscopes under which many of these slides were shown.

The thanks of the Society were unanimously voted accordingly.

The following Instruments, Objects, etc., were exhibited:—

The Society:—The following slides lent for exhibition by Mr. Flatters: *Amphioxus*, young; *Amphiura squamata*; *Antedon rosacea*, pentacrinus larva; *Aphis*, sp.; *Asterina gibbosa*, vertical and horizontal sections; Box Fish, scale; *Dasychone luculana*, plume; *Echinus esculentus*, ova; *Echinus* sp., section of spine; *Haliclystus octoradiatus*; *Heteronereis Dumerilli*; Hive-bee, Drone, horizontal longitudinal section of eyes; *Lepas pectinata*, young; *Mysis*, sp., young, showing auditory organ in tail; *Nausithoë punctata*, Medusa; *Obelia geniculata*, branch with polyps expanded; Ditto, Medusa; *Pallene*, sp.; *Platessa vulgaris*, young; Ditto, young, showing migration of eye; *Pyrosoma elegans*, larva; *Sapphirina*, sp.; *Tubularia larynx*; *Volvox globator*; and the following instruments presented to the Society by Mr. Peyton T. B. Beale: Powell and Lealand No. 2 Stand (1885); Powell and Lealand No. 3 Stand (1848); Hugh Powell Tank Microscope; Microscope Stand and Eye-piece by W. J. Salmon; Microscope Stand and Eye-piece by W. Matthews; 5 Low Power Objectives by S. Highley.

Mr. J. W. Gordon:—Lantern Slides in illustration of his paper on "An early criticism of the Abbe Theory."

Mr. A. E. Conrady:—Exhibit to show that diffraction spectra cannot be done away with by using critical light.

Dr. R. G. Hebb:—Slide of *Macrobiotus indica* in illustration of Mr. Jas. Murray's paper on "Some Tardigrada from the Sikkim Himalaya," and a Slide of *Bulmiella indica* in illustration of Dr. Eugène Penard's paper "On Some Rhizopods from the Sikkim Himalaya."

MEETING

HELD ON THE 20TH OF MARCH, 1907, AT 20 HANOVER SQUARE, W.
DR. J. W. H. EYRE, VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 20th of February, 1907, were read and confirmed, and were signed by the Chairman.

The following Donation to the Society was announced, and the thanks of the Meeting were voted to the donor.

	From
A Solar Microscope by Nairne	*Mr. F. R. Tindall Lucas.*

In reference to the Old Solar Microscope presented to the Society by Mr. F. R. T. Lucas, Mr. Rousselet mentioned that they had not hitherto possessed any Microscope by the same maker—Nairne—and were therefore very pleased to add it to their collection. Unfortunately it was incomplete. It probably dated from the beginning of the last century.

Mr. Murray's paper on "Some South African Tardigrada," collected by Mr. Milne of Uitenhage, was read by Mr. Rousselet, and was illustrated by plates of the species referred to, and by specimens exhibited under Microscopes in the room.

Mr. Hardy's paper "On *Myxonema tenue*" was read by Dr. Hebb.

Mr. C. L. Curties exhibited a new form of removable mechanical stage giving a lateral movement of 2 in., which it was thought would prove of advantage in cases where it was necessary to examine a long smear of blood or other matter. The vertical movement of this stage had the usual 1 in. movement.

The Chairman thought this was a very useful form of mechanical stage, giving an extensive horizontal movement, which was often desirable in the examination of blood films.

Mr. A. E. Hilton, who had arranged an exhibition of specimens of British Mycetozoa under a number of Microscopes in the room, gave an interesting account of the life-history of these organisms, illustrating his remarks by drawings on the board. It was pointed out that, although formerly classed amongst the Fungi, their life-cycle is essentially different, for while in their sporangial stage they resemble Fungi, in their subsequent amœboid and plasmodial stages they are quite distinct, the plasmodial being their really distinctive stage, differentiating them from all other groups.

The Chairman said they were greatly indebted to Mr. Hilton for the excellent exhibition which he had arranged for them, and not less so for his very interesting and lucid description of this group of organisms.

Dr. D. H. Scott pointed out that the statement as to the existence of fossil Mycetozoa was made by the late M. B. Renault, an authority entitled to the highest respect. The evidence, however, appeared insufficient to demonstrate the presence of these organisms, for though there was no reason why the sporangia should not be preserved, the plasmodium, to which the statements referred, was a body one could scarcely expect to identify in petrified material. Organisms of various kinds were often found within the cells of petrified plant remains, and it was possible that some of these might be allied to parasitic or saprophytic Mycetozoa.

He should like to thank Mr. Hilton for his clear exposition of this interesting group. The question of a possible fusion of nuclei, to which Mr. Hilton had referred, was of great importance. Professor Sachs, in his "Text-book of Botany," had included the Mycetozoa in his Zygosporæ, regarding the fusion of the Myxamœbæ as a sexual process, but this view had been disproved by the discovery that no fusion of nuclei was involved. It would be extremely interesting if it were proved that at any stage such nuclear fusion really occurred.

The thanks of the Society were heartily voted to Mr. Hilton for his communication.

Mr. Ersser read a short description of a slide of Trypanosoma which he exhibited under a Microscope in the room.

The Secretary read a letter from the Hon. Secretary of the Selborne Society, inviting the assistance of the Fellows of the R.M.S. as exhibitors of microscopic objects at the Selborne Society's soirée on April 26.

A letter was also read from Mr. Holloway, stating that he had sent a small quantity of Oamaru diatomaceous earth for distribution amongst such of the Fellows of the Society as wished to have any of this material. Applications for it to be made to Mr. Parsons.

The Chairman said they were greatly indebted to Messrs. Baker for the loan of a number of Microscopes under which Mr. Hilton's specimens were being exhibited that evening, and he had much pleasure in proposing a hearty vote of thanks to them for their kindness.

The thanks of the Society were voted to Messrs. Baker accordingly.

It was announced that the rooms of the Society would be closed for Easter from March 28 to April 2.

New Fellow.—Mr. William Archibald Clowes was balloted for and duly elected a Fellow of the Society.

The following Instruments, Objects, etc., were exhibited:—

The Society:—An Old Solar Microscope by Nairne.

Mr. C. L. Curties:—New removable Mechanical Stage.

Mr. T. D. Ersser:—*Trypanosoma gambiense*, from West Africa, under a Zeiss F, $\frac{1}{14}$-inch dry objective, N.A. 0·90, and a Kellner Orthoscopic Achromatic Eye-piece.

Mr. A. E. Hilton:—The following Slides of British Mycetozoa: *Arcyria albida*, Sporangia before dispersion of spores; *A. punicea*, Sporangia showing capillitium after dispersion of spores; ditto, Sporangia with ruptured walls; *Badhamia foliicola*, Sporangia, on rush; *B. hyalina*, var. *genuina*; *Comatricha obtusata*, Sporangia after dispersion of spores; *Craterium pedunculatum*, Sporangia; *Diachæa elegans*, Sporangia; *Didymium difforme*, Plasmodicarps; *D. effusum*, Sporangia; *Hemitrichia rubiformis*, Sporangia, some with protruding Capillitia; *Lamproderma irideum*, Sporangia; *Oligonema nitens*, Sporangia, cultivated on tan; *Physarum cinereum*, Sporangia, some ruptured, showing Capillitia heavily charged with lime; *P. nutans*, Sporangia heavily charged with lime; *Trichia affinis*, Sporangia; *T. botrytis*, var. *subfusca*, confluent cluster of Sporangia forming stipitate æthalium.

Mr. C. F. Rousselet:—Drawings and the following Slides in illustration of Mr. J. Murray's paper on "Some South African Tardigrada": *Macrobiotus nodosus*; *Echiniscus perarmatus*; *E. africanus*.

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AND

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MICROSCOPY, &c.

EDITED BY

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WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

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Regius Professor of Natural History in the University of Aberdeen

A. N. DISNEY, M.A. B.Sc. CECIL PRICE-JONES, M.B. Lond.

FELLOWS OF THE SOCIETY

AND

A. B. RENDLE, M.A. D.Sc. F.L.S.
Keeper, Department of Botany, British Museum

HAROLD MOORE, B.Sc.
Woolwich Arsenal

Minimis partibus, per totum Naturæ campum, certitudo omnis innititur
quas qui fugit pariter Naturam fugit.—*Linnæus.*

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11

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The radius of curvature of the incident wave-front (i.e. the distance of the image of the slit from the grating) expressed in units of $\frac{1}{10000}$ of an inch.

FIG. 4.

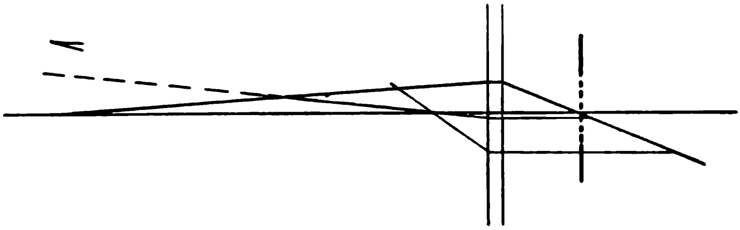

FIG. 3.

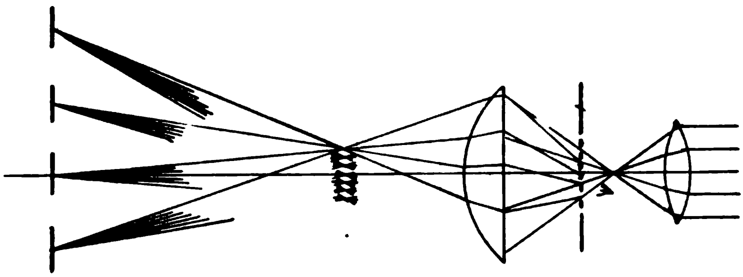

FIG. 2.

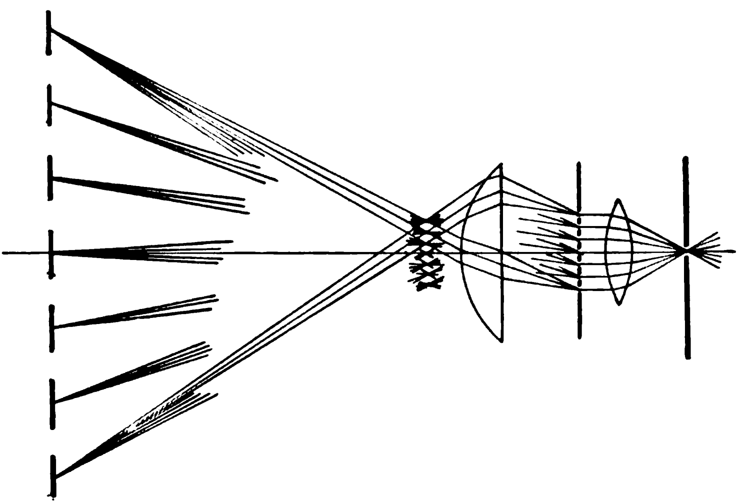

FIG. 1.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1907.

TRANSACTIONS OF THE SOCIETY.

V.—*An Early Criticism of the Abbe Theory.*

By J. W. Gordon.

(*Read February* 20, 1907.)

Plates XII. and XIII.

On reading my copy of the December Journal I find myself referred to in a paper presented to the Society on October 17 last by Mr. A. E. Conrady, and as I may have unintentionally appeared wanting in courtesy to the Society in general and to the author of the paper in particular, inasmuch as I took no part in the discussion, I will ask leave to explain that my silence was only due to the fact that I was wholly unaware of what was proceeding; it not having occurred to the author of the paper to give me notice that I should be put on my defence.

The point made against me is that my criticism of the Abbe theory contained in a paper read before the Society in June, 1901, and printed at page 353 of the volume for that year of the Society's Journal had been anticipated by a certain Professor Altmann twenty years before and answered in effect by Professor Abbe in his paper "Uber die Grenzen der geometrischen Optik." I appreciate that Mr. Conrady has absolved me from the necessity of showing that I did not borrow from Altmann's paper, but it is not altogether irrelevant to what I have to say if I mention that I have never seen that paper, and I had never even heard about it until some six months ago when I read in Abbe's Collected Works the above-mentioned paper on the limits of geometrical optics.

With regard to the matter of substance, I have to point out that between Altmann's paper and mine there is—to judge from

Professor Abbe's references to the former—no single point in common, unless the aërial image of a diffraction grating—concerning which I will add an observation in the next paragraph—be such a point. Altmann's paper is based upon Helmholtz's paper of 1874, concerning which I read a paper before the Society in March 1903 (Journal, p. 381), but when I wrote my paper on the Abbe theory I had not read and had not even heard of the paper written by Helmholtz. It was therefore actually impossible for me to traverse the same ground as Professor Altmann, and, in fact, as I say, the only point which I gather to be common to the two is the experiment with an aërial image of a diffraction grating. The substantial difference between the two papers will sufficiently appear from Mr. Conrady's account of the Altmann paper. He says (p. 645), "Altmann's theory thus tries to account for the image under all conditions on Helmholtz's basis," and (p. 646) "For the Abbe theory Altmann has little but smiles and sneers." With the first of these points I have already dealt. My paper on the Abbe theory was entirely innocent of any relation to the Helmholtz basis, for the simple reason given above, that when it was written I knew nothing about the Helmholtz basis. With regard to the second feature of Altmann's paper, I hope that it is not necessary for me to protest that in discussing the Abbe theory I have had no recourse either to smiles or to sneers.

Now to deal very briefly with the aërial image point. It will be remembered that in the experiments described by Dr. Zimmermann, in proof of the Abbe theory, a prominent place was given to the intercostals, which appear when a diffraction grating is viewed through certain diaphragms placed in the back focal plane of the objective. In comparison with this experiment I showed another in which side by side with the Abbe *diffractionsplatte* on the stage of the Microscope was an aërial image of a grating, the image having the same dimensions as the real grating by its side. These two objects, viewed through the same diaphragm, presented precisely the same appearance, the image being obviously incapable of yielding a diffraction spectrum.

EXPLANATION OF PLATE XII.

Fig. 1 shows the apparatus arranged in the manner prescribed by Professor Abbe for making his experiment. It also illustrates the formation upon this system of the spectrum of the grating in the principal back focal plane of the objective.

Fig. 2 shows the same apparatus re-arranged for the purpose of the experiments described in the paper, in which the image of the slit is formed between the condenser and the grating, so that the distance of the source of light from the grating can be varied at will. It illustrates the formation of the spectrum in a plane conjugate to the position of the image of the slit.

Fig. 3 is a Gauss diagram illustrating the law of the formation of the spectrum, by which its position, type, and dimensions are determined.

The conditions of illumination were in fact such—the source of light being focused on the stage of the instrument—that even the real diffraction grating showed no spectrum. For diffraction only occurs when the same wave-front passes through two or more apertures of a grating. It only occurs, therefore, when the incident wave-front has a finite magnitude, and, consequently, if the grating is itself the source of light, or if it coincides with any plane in which an image of the source of light is focused, no diffraction spectra can arise from it. This is not only a theoretical result: it can be very easily verified to the eye by removing the ocular from the Microscope when a diffraction grating is on the stage of the instrument, and inspecting the back focal plane in which these spectra are formed. If now, by moving the condenser, the image of the source of light be brought nearer and nearer to the plane of the grating, it will be found that, as the radius of the incident wave-front shortens, the spectra crowd closer and closer together, and when at last the image of the light source coincides with the grating, these spectra have all disappeared, being absorbed in the central image with which they all now coincide. This phenomenon was very fully explained in my paper on the Abbe theory (p. 366), and was illustrated experimentally at the meeting at which the paper was read.

We are now informed that this experiment, or something more or less resembling it, was put forward by Professor Altmann. How close the resemblance was we cannot well judge, for we are not told whether Professor Altmann made it a condition of his experiment that the source of light should be focused in the plane of the original grating. It would indeed be most natural to

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EXPLANATION OF PLATE XIII.

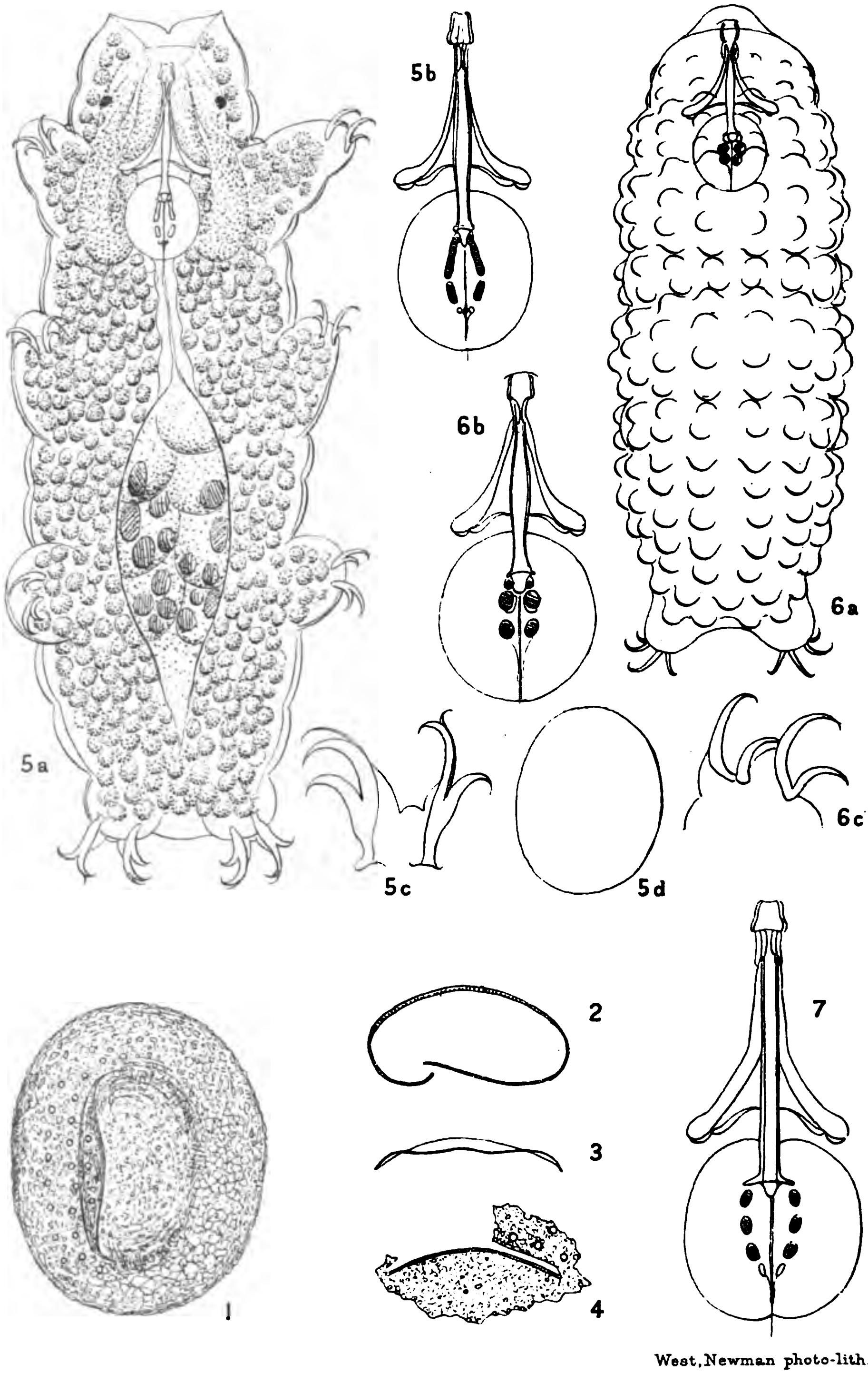
Fig. 4.—Contains photographs of the various images formed by the grating (an Abbe diffractionsplatte) of the source of light when the position of this latter is varied, as stated in the diagram. It is to be observed that as the distance between the source of light and the grating gets shorter, the spectrum becomes more and more compressed; that when it reaches a point in the tube at which the pencils from various openings in the grating separate out from one another, the spectrum (at a distance of 0·002 in.) loses the character of a grating spectrum, and conforms to the type of spectrum formed by a single opening. At this point Abbe's rule that two spectra or more are required for the formation of a resolved image, ceases to hold good, since the central beam of the spectrum formed by a single opening is alone sufficient for the purpose. When the source of light coincides with the grating, there is an image of the one superimposed upon an image of the other, but no spectrum of any sort.

[To prevent a mistake which appears to be possible, it should be added, that in these experiments the Abbe slit cannot be replaced by a lamp-flame arranged "end on" towards the Microscope. The difficulty in that case is that the flame is so extended along the optical axis, that wherever it may be placed some part of its image will be far enough from the grating to give rise to a spectrum of the grating type.]

assume that this would be so, as otherwise there would be an unnecessary loss of illuminating power. And, on the other hand, it is difficult to suppose that he did stipulate for this condition, for we are told that Professor Abbe answered him by pointing out "that the original grating produces diffraction spectra, and that these, as well as the direct light, are refracted by the lens forming the aërial image, and thus supply this latter with an exactly similar set of diffraction spectra." To the case which I put forward this would obviously be no answer at all—it would be sheer nonsense—for I postulated a condition of illumination which abolishes diffraction by the original grating; I showed by actual inspection that the spectra were missing and demonstrated by a preliminary experiment what had become of them—to wit, that they had all been merged in the "dioptric" image.

Another point in which Professor Altmann's paper is said to anticipate mine is that it is "an attempt" to show that "images are composed of diffusion disks," formed according to Helmholtz' theory of 1873. This, however, is a mere mistake. I made no attempt to show anything of the kind. The fact has been matter of common knowledge at least ever since the publication of Sir George Airy's paper in 1835, and I took it for granted, as Helmholtz himself took it for granted in 1873, and as, I suppose, every other writer on the subject has taken it for granted since Airy's time. Professor Altmann was too late in 1880 to anticipate anybody on this point.

There is one other point in Mr. Conrady's paper to which I should like to allude for the sake of registering, with all humility, my concurrence in one of Professor Abbe's positions. We are told that he pointed out a certain difference as being "the real distinction between his theory and that of Helmholtz." This difference is stated too concisely to be intelligible to me, and I therefore do not presume to express either assent or dissent as to the precise definition of the difference. But I know quite well what the difference is, and I entirely agree that it amounts to a real distinction. In the Abbe theory no account is taken of the diffraction which arises in the apertural plane of the Microscope, but only of that which arises in its focal plane. In the Helmholtz theory no account is taken of diffraction which arises in the focal plane, but only of that which arises in the apertural plane. No distinction could be more complete. The two theories have nothing whatever in common.



West, Newman photo-lith.

Indian Rhizopods and Tardigrada.

VI.—*Some Tardigrada of the Sikkim Himalaya.*

By JAMES MURRAY.

(*Read February* 20, 1907.)

PLATE XIV.

THE Tardigrada enumerated in this list were obtained from moss sent by Mr. A. Gage, Superintendent of the Royal Botanic Gardens, Sibpur, to Mr. N. D. F. Pearce, Cambridge. There have already appeared in this Journal lists of species of several groups obtained in this moss—Oribatidæ (p. 269, June, 1906); Rotifera (p. 637, Dec., 1906)—and Dr. Penard's account of the Rhizopods appears in this same number.

There are 14 species in the list, comprising 4 species of *Echiniscus*, 8 of *Macrobiotus*, 1 *Diphascon*, and 1 *Milnesium*. Two of the species of *Macrobiotus* were previously undescribed.

There are besides many forms, some of them doubtless distinct from any known species, which could not be sufficiently studied.

Five of the identifications are not absolutely certain.

Genus *Echiniscus*.

E. arctomys Ehr. (*3*).—In one sample only, from Gokdhara, 3000 ft.; several examples living.

E. mutabilis Murray (*4*).—In two samples, both from Sinihul, 8000 ft. They belonged to the type of the species, with large dots on the plates, and the barbs of the inner claws were seen. Many living, and some skins with two or three eggs.

E. reticulatus Murray (*4*).—Sinihul, 8000 ft., several living, and one skin with four eggs.

E. quadrispinosus Richters (?) (*8*).—Darjiling, 6000 ft., and

EXPLANATION OF PLATE XIV.

Fig. 5*a*.—*Macrobiotus rubens* sp. n. Ventral view.
„ 5*b*. „ „ Teeth and pharynx.
„ 5*c*. „ „ Claws.
„ 5*d*. „ „ Egg.
„ 6*a*.—*M. indicus* sp. n. Dorsal view.
„ 6*b*. „ „ Teeth and pharynx.
„ 6*c*. „ „ Side view of claws.
„ 7.—*M. echinogenitus* Richters var., teeth and pharynx.

Baghghora, 6000 ft. This animal is doubtfully united to Richters' species because the arrangement and texture of the main plates are the same as in examples of *E. quadrispinosus* which Professor Richters was kind enough to give me, and because the larva has, as Richters states (*9*) only the two lateral processes *a* and *e*. There are several points of difference which render the identification doubtful, but as only young individuals were seen (two-clawed larvæ and four-clawed examples hardly larger than the larvæ), it would be unsafe to build on these differences. The larvæ had no dorsal processes; the subsidiary plates among the larger plates were not detected; the lateral spine *e* had a thick basal portion, with a shoulder, succeeded by a thin apical portion. The two-clawed larva had four claws developed on the new skin inside. Several examples 150μ long.

Genus *Macrobiotus.*

M. hufelandi C. Sch. (*12*).—Common in moss from Sinihul, 8000 ft., and Baghghora, 6000 ft. There is always an amount of doubt about an identification of a *Macrobiotus* if the egg is not seen (compare *M. rubens* below, which closely resembles *M. hufelandi*, but has a quite different egg). Typical eggs of *M. hufelandi* were also abundant, and some well-developed young were squeezed out of eggs.

M. rubens sp. n., plate XIV. fig. 5*a* to 5*d*.

Specific Characters.—Of moderate size and reddish-brown colour. Eyes present. Pharynx of *hufelandi* type, with a nut attached to the gullet, a long double rod, a shorter rod, and a comma in each row. Claws of *hufelandi* type, joined about half-way. Egg oval, laid in the skin.

Length, up to 430μ. Eggs up to five in one skin. There appears to be only one supplementary point to each long claw, but this is difficult of demonstration. It is the first species known to me, of the *hufelandi* type of claws, which does not lay a spiny egg. As both claws and pharynx conform to the *hufelandi* pattern, the distinction from that species would be difficult if the eggs were not seen. The clear ruddy colour is quite distinct from the dull brown pigment of *hufelandi*, but is lost in preserved specimens. The colour, as in *M. coronifer*, etc., is in the fat-cells. Baghghora, 6000 ft., numerous.

M. intermedius Plate (*6*).—This species I only know with certainty as a Scottish species by the distinctive egg. As to its other structures, I gather from identifications made by Professor Richters that it has claws of the *hufelandi* type, and pharynx of the *echinogenitus* type. No eggs of the species have

been found in India, but an animal having the other structures, viz. claws united halfway and pharynx with three short rods in each row, besides a nut joined to the gullet, and a "comma," was abundant in moss from Baghghora, 6000 ft., and Gokdhara, 3000 ft.

M. echinogenitus Richters (*10*).—The adult animal and typical eggs occurred in several samples of moss, from Sinihul, 8000 ft., and Baghghora, 6000 ft.

Var. *areolatus* (Murray, Arctic Tard., *13*). — Both eggs and adults in three samples of moss from Sinihul, 8000 ft. This form, which I expect to prove of specific value, is distinguished by the areolations, hexagonal or rounded, between the spines of the eggs. The animal, which has frequently been squeezed out of the egg, further differs from the type in that the pharynx always lacks the comma, and the claws are joined for a short distance above the base. Abundant.

Variety of egg.—A large egg of the *echinogenitus* type containing an embryo with the typical pharynx, but having most of the spines forked. Sinihul, 8000 ft.

Variety (fig. 7).—Pharynx and claws of *echinogenitus* type. End of gullet, in pharynx, with unusually wide, divergent flange. Teeth abruptly angled in middle, both portions straight. In the mixed collection; locality unknown.

M. macronyx Duj. (?) (*1*).—A few examples, Sinihul, 8000 ft., were identified as this species. In view of the discovery that the supposed *macronyx* of Scotland, now called *M. dispar* (*5*), has spiny eggs, it becomes uncertain to which species the Indian examples should be referred.

M. oberhäuseri Doy (?) (*2*).—There is no agreement among authors as to this species. The pigment bands, which seem to be generally accepted as the most reliable character, may be absent. No one appears to have found the mulberry-form eggs of Doyère's diagnosis, and connected them with the pigmented animal. Accepting Professor Richters' identification, I find in India several animals having the claws and pharynx as in examples which Richters has kindly sent me from the Taunus. The claws are of the structure usual in the genus *Diphascon*, and called the *oberhäuseri* type, from this species, and the pharynx has a conspicuous nut joined to the gullet, and two short equal rods, or round nuts, in each row. In moss from Baghghora, 6000 ft., and in the mixed collection; frequent.

M. indicus sp. n., plate XIV. figs. 6*a* to 6*c*.

Specific characters.—Very small; claws of *echinogenitus* type V-shaped, one of each pair slightly longer; pharynx nearly round

of *oberhäuseri* type, with a nut joined to the gullet and two larger free nuts in each row; egg smooth, oval, in skin. Skin tubercled, warts in many transverse rows, and many in each row.

Length about 150μ, pharynx 18μ, claws 7μ, fat-cells 6μ, egg 42 by 30μ.

The species resembles *M. tuberculatus* Plate (*6*), and *M. ornatus* Richters, var. *verrucosus* (*7*). From *M. tuberculatus* it differs in the type of pharynx (two round nuts instead of three); the warts much smaller and more numerous in each row. The rows are also more numerous. *M. tuberculatus*, if I understand it aright, has four or six large tubercles on each segment, and a similar row on each secondary intermediate segment. *M. indicus* has several rows of tubercles on each segment and intermediate segment.

It is much nearer *M. ornatus* var. *verrucosus*, which has the same type of pharynx, but is distinguished by the larger and regularly arranged tubercles, those of *verrucosus* being of unequal sizes and scattered.

M. sattleri Richters (*8*).—One example, Singla, 2000 ft. Very small, 150μ long; pharynx with nut fixed to gullet, and three free nuts increasing in size from first to third. This is the same kind of pharynx which I have seen in what I suppose to be *M. tuberculatus*, to which Richters considers this species to be related.

Genus *Diphascon.*

D. chilenense Plate (*6*).—The only common species of this genus in the Indian moss comes nearest *D. chilenense*, though there is some doubt as to the identity. The pharynx is shortly oval, never as broad as long, and it is often as narrow and elongate as in *D. alpinum*. In all the forms there were three very short equal rods, besides a nut and a comma. Sinihul, 8000 ft.

D. sp. (?) A very small form, with very long slender gullet, and shortly oval pharynx, having only two short rods, besides the nut and comma. Being a reduced form, without bearers or teeth, it cannot be named.

Cysts of Diphascon.—In the one sample from Singla, 2000 ft., there were several cysts of a *Diphascon* with oblong pharynx, without rods (simplex form), and possessing eyes.

Genus *Milnesium.*

M. tardigradum Doy (*2*).—Fairly abundant in moss from Darjiling, 6500 ft., and Baghghora, 6000 ft. The shorter claws of these examples had all three points.

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VII.—*On Some Rhizopods from the Sikkim Himalaya.*

By EUGÈNE PENARD, Docteur ès-sciences (Genève).

(*Read February* 20, 1907.)

PLATE XIV.

Bulinella indica g. et sp. n.

THIS rhizopod, which Mr. James Murray found in several samples of Himalayan moss, sent to him by Mr. N. D. F. Pearce, of Cambridge, and which he submitted to me for study, seemed to me at first to belong to the genus *Centropyxis*, but in reality it differs from that genus in some important characters.

In *Centropyxis* the shell consists primarily of a chitinoid membrane, punctate over its whole surface with a multitude of little points, usually very obscure, and distantly recalling the characteristic structure of the genus *Arcella*, and to this membrane there adhere particles of extraneous matter, more or less numerous.

In *Bulinella* it is the extraneous matter, in the form of thin silicious plates, which forms the shell itself, joined together by a chitinous cement, more or less abundant. Moreover, the buccal opening is not, as in *Centropyxis*, a more or less rounded depression, invaginate or tubular, but a slit, long and very narrow, the plane of opening of which is tangential to the surface of the shell. Two lips can be distinguished, of which the lower, so to speak, passes under the upper, producing an appearance which recalls that of certain molluscs, such as *Bulla*, hence the name *Bulinella* applied to the new genus.

In *Bulinella indica*, which will be the type of the genus, the shell, measuring 160–200μ in greatest diameter (which is its *width*, as indicated by the position of the mouth), is arcelloid in

EXPLANATION OF PLATE XIV.

Fig. 1.—*Bulinella indica*, ventral face.
,, 2.—Diagrammatic section, antero-posterior.
,, 3.—Contour of the lips, seen from above. The thick line indicates the upper lip, the thin line the lower lip.
,, 4.—Broken fragment of a shell, from the buccal region. The arched lower lip is seen with its anterior thickening, and a part of the upper lip, with several pores, the fracture passing through two of these.

form, depressed, having the dorsal face rounded and the ventral flat or slightly concave in the centre; seen from above (fig. 1) the shell has an elliptical, not circular, contour, the greater diameter being to the lesser, usually about as 4 : 3. The shell is formed of little silicious particles, derived from without, always flat and thin, varying in size in different individuals, and always smaller in the vicinity of the mouth. These particles, themselves colourless, are joined by a chitinous cement, which forms a network of nerves, and sometimes extends over the plates, giving the shell a yellowish-brown tint, often inclining to black or to chocolate-brown. The proportion of chitin is greatest on the peristome.

There are never processes or horns such as are found in the genus *Centropyxis.*

It is on the flat face, which I regard as ventral or inferior, that the buccal slit opens; parallel to the line of greatest diameter, and at about one-third of the distance from one margin of the shell to the opposite margin, is seen the upper lip, like a narrow band, long, dark-coloured, rather variable in form, but most commonly arched or undulate on its anterior border, the two ends vanishing in points towards the commissures which unite it to the lower lip.

This upper lip, slightly incurved, is formed of minute silicious particles, joined by a very abundant chitinous cement, and round the whole periphery, as far as the commissures, one sees here and there little clear spots, round or elliptical, which are, in fact, perforations.

These, pores, $2 \cdot 5$–3μ in diameter, with a yellowish border, often raised into an annular edge, are usually about thirty in number. They are not very regularly disposed, but sometimes a kind of symmetry in their arrangement can be detected; at all events they are never grouped all close together. The pores are lacking on the lower lip, though sometimes, and exceptionally, one or two extend on to the central portion of the inferior face of the shell.*

To form the lower lip the ventral surface is slightly depressed, forming a shallow basin, composed of small silicious particles, strongly veined with chitinous deposits. Reaching the buccal commissures, where the corners of the upper lip are abruptly bent down to meet it, the free anterior edge of the concavity is continued forward under the upper lip, thus forming a lower lip, arched forward in a curve of regular convexity (fig. 3).

* If we suppose the animal creeping in the natural position, *viz.* with the ventral or buccal face downwards, what I have called the upper lip will really be in a lower position, in relation to the substratum, but it seems to me that we must regard as the upper lip that border of the mouth which is external, and further from the centre of the plasma, and as lower lip that border which is internal, or nearer the centre of the plasma.

As, moreover, in addition to the fact that at the peristome the envelope is darker-coloured, the upper lip overhangs the lower, the double thickness of the envelope, increasing the opacity, appears to the eye as a longitudinal ribbon, darker than the rest of the surface.

The buccal orifice is thus reduced to a long narrow fissure, tangential to the surface of the shell, and so disposed that the plasma, in making its way to the surface, must necessarily form a living mantle, creeping over a floor and covered by a roof (fig. 2).

This plasma, it must be admitted, remains unknown to us; the collections when studied had been for some time in formalin. What of the pseudopodia, are they broad or filiform, *lobosa* or *filosa*? Very probably, when we consider the apparent affinities of the organism, they will be found to be broad, and the species will belong to the Thecamœbæa lobosa; but the fact is not established.

The moss in which these rhizopods were found had been in the dry state for some time before being put in formalin, and some animals had had time to encyst themselves. Though the majority of the shells were empty, some still contained their plasma, and when the plasma was exposed by the tearing of the envelope, it appeared as a spherical mass, covered with a fine pellicle, and in the interior of which could be seen some pellets of food. As to the nucleus nothing can be stated with certainty; the half-dozen cysts which I was able to study after staining with carmine (the staining, moreover, never very successful), showing merely, for the most part, a faint and unequal colouring. In one of them a darker tract of very irregular outline, seemed to indicate the presence of a nucleus, but might on the other hand be merely some animal prey with easily coloured flesh. In another, the best stained among those examined, there were, disseminated throughout, a considerable number of little globules, of 3μ in diameter, darker in colour than the rest of the plasma, and which it seemed to me could be nothing else but nuclei. This hypothesis is rendered the more plausible by the fact that, in the uninucleate rhizopods, which have a large nucleus, it rarely happens that the reaction of the carmine, even under unfavourable conditions, fails to reveal that organ, while in the plurinucleated species, in which the nuclei are small in proportion as their number is greater, they are often with difficulty distinguished.

Bulinella indica is at any rate almost beyond doubt a rhizopod, the study of which in life could not fail to yield interesting discoveries.

If we recapitulate in a short diagnosis the characters of this organism, they may be stated as follows:—

Bulinella g. n.

Shell pierced on the ventral face by an elongate narrow slit, constituting a peristome with a smooth inferior lip and an overhanging superior lip pierced with pores.

Bulinella indica, sp. n.

Shell arcelloid, of elliptical contour, brownish, composed of silicious particles soldered together by chitinous matter, thin and flat, smaller in the buccal region, Mouth opening by a long narrow slit in tangential direction, with an inferior lip which by its convex anterior border is prolonged a little forward, and a superior lip of irregular or undulate outline, which projects over the inferior lip.

Rounded pores, 2–3μ in diameter, disposed in unequal series all over the upper lip.

(?) Numerous nuclei of 3μ in diameter.

Mean size 170–200μ (following the greatest diameter of the shell, that is to say its *width*).

Antero-posterior diameter, perpendicular to the buccal slit, 120–140μ.

Localities—Gokdhara, 3000 ft., Sukvar, 4000 ft.

List of all the Species Observed.

Bulinella indica g. et sp. n.

Centropyxis aculeata Stein.—Under various forms, abundant at all elevations, from 4000–8000 ft.

C. ecornis (Leidy, Freshwater Rhizopods of North America, 1879, plate xxx. figs. 30, 31).—In moss from Gokdhara, 3000 ft.

C. lævigata Penard.—Gokdhara, 3000 ft.; rare.

Difflugia arcula Leidy.—Sinihul, 8000 ft., Baghghora, 6000 ft., Gokdhara, 3000 ft.

D. constricta Ehr.—Under several forms, one large and fine, without spines, answering to Leidy's plate xviii. figs. 35–36. Common in nearly all the samples, 2000–8000 ft.

D. pyriformis Perty.—Answering in form to Leidy's plate x. fig. 18; resembling, in fact, *D. bacillifera* Penard, but covered with stones instead of diatoms; not very rare, Sinihul, 8000 ft.; also small variety, Sinihul.

Heleopera petricola Leidy.—In many samples, Sinihul, 8000 ft., rather large; Baghghora, 6000 ft.

H. rosea Penard.—Baghghora, 6000 ft., abundant, but under a peculiar shape.

H. cyclostoma Penard.—Abundant in nearly all the samples from all elevations.

Nebela collaris Leidy.—Sinihul, Baghghora, and Gokdhara.

Small variety, resembling *N. bursella,* but without pores behind the mouth; Sinihul.

N. caudata Leidy.—Sinihul and Baghghora; abundant.

N. lageniformis Penard.—In about ten samples of moss, from all elevations.

Phryganella hemispherica Penard.—Sinihul.

Euglypha ciliata Ehr.—Common at all elevations.

Trinema euchelys Ehr.—Sinihul and Baghghora; large and beautiful, wide and inflated.

VIII.—*Notes on a Peculiar Habitat of a Chlorophyte, Myxonema tenue.*

By A. D. Hardy, F.L.S., F.R.M.S.

(*Read March* 20, 1907.)

That several species of unicellular algæ, commonly attached to filamentous forms, and to *Nitella*, *Chara*, etc., are also to be found leading an epizoic existence, is, I think, well known. The hosts in such cases are mostly Entomostraca, e.g., *Simocephalus elizabethæ*, *Daphnia carinata*, *Cyclops quadricornis*, or aquatic larvæ of Coleoptera, etc., the algæ attached to these being species of *Characium* or *Characiopsis* which often share space with species of *Vorticella* or *Epistylis*.

The present notes refer to other algæ and an unusual host which came under my notice in November, 1906, through the death of some "gold-fish" or carp (*Characius auratus*). The circular pond in which the fish were kept is constructed of brick, with cemented surfaces, and has a diameter of about 3 metres and a depth of about 1·5 metre, containing, in addition to quartz-pebbles and rocks, several flower-pots and wooden boxes in which water-lilies are rooted. The water was kept fresh by means of a pipe from the metropolitan supply of good drinking water, in the form of a fountain-spray, the water escaping from below the raised surface. To the rocks and flower-pots, and to the leaves and leaf-stalks of the macrophytes, much algal growth adhered, the whole pond having a neglected appearance, though it had been thoroughly cleansed a few weeks previously.

Twelve or more carp swam about, apparently in good health, but two or three others were sluggish in movement, and when caught were found to be diseased. On the backs of these, extending in patches from near the eyes to about the posterior end of the dorsal fin, grew flocculent impedimenta which had interfered with swimming, retarding the movement of the fish much as barnacles and other marine attachments impede a ship's progress. Owing to etiolation the algal nature of the growth was not suspected, but became evident on inspection of the third fish caught, which bore a luxuriant growth, parts of which, covering patches of several square

centimetres, were of the characteristic chlorophytal colour and had filaments from 1 to 2 cm. in length. Microscopical examination showed this larger and principal growth to be *Myxonema tenue* (Ag.) Rabenh. with creeping rhizoidal parts imbedded in the slime or attached to the scales or epidermis; while inmeshed by this, partly epiphytic, and partly held by slime, were several other healthy but chiefly unicellular algæ which are named at the end of this paper.

It may be recorded here that *Myxonema tenue*, when found in this locality, is usually in stone-paved gutters in which there is a rapid flow of water, or in other fast-flowing streams, either large or small, sometimes epiphytic on submerged twigs of *Salix babylonica*, or on the stems and leaves of river-side herbs such as *Polygonum minus* and *Triglochin procera*, but more often attached to stones or dead twigs. In the fish-pond, where the water was almost stagnant, this alga grew, poor in quality, on stems and leaves of macrophytes, but in comparative luxuriance on the backs of at least three fishes. I think that some interest, therefore, attaches to the adaptation of this stream-loving *Myxonema*, which, finding the almost stagnant water of the pond unsuitable, had, by means of its zoogonidia, obtained a footing, either by accident or design, on moving objects, thus obtaining the desired water-friction to which the species had been accustomed.

The ultimate effect of the algal growth on the fishes, however, was in each case the premature death of the host, which was preceded by a gradual loosening, in places, of the scales, which eventually dropped off, the fishes probably contributing to the displacement by brushing against projections to relieve themselves of the source of irritation.

Parts of the fish, which bore the algæ, showed white patches or small spots in the transparent slime, caused by a fungus, and as the mycelial threads were found also associated with the algæ, it is possible, or even probable, that a fungus-growth, set up through an unhealthy condition of the fishes' epidermis or slime, paved the way for the growth of the chlorophyte. In places, also, where the scales of the fishes had dropped or been forced off, the alga had gained a foothold, and thus evidently was not dependent on the scales or the crevices between them, but rather on the slime of the epidermis itself, as sometimes, but not always, a considerable amount of force was required to detach it.

The following is a list of the algæ obtained from a small tuft of *Myxonema* not more than 0·5 cm. in area, the branched filaments being 1·5 to 2 cm. long. The *Pediastra* and unicellular species inmeshed among them may have become attached subsequent to the growth of the *Myxonema* during the efforts of the fish to rub off the latter against algæ-covered objects.

Pediastrum tetras (Ehrenb.) Ralfs.
P. Ehrenbergii Corda.
Scenedesmus quadricauda (Turp.) Bréb.
Ankistrodesmus falcatus (Corda) Ralfs.
Selenastrum acuminatum Lagenh.
Sphærocystis schrœteri Chodat.
Synedra pulchella Kütz.
Stauroneis sp.
Navicula sp.

IX.—*An Improved Vertical Illuminator.*

By Edward M. Nelson.

(*Read May* 15, 1907.)

The accompanying figures, which need hardly any explanation, show an improved form of vertical illumination. The nose-piece (fig. 49), which is cylindrical, contains a 45 degree plane glass mirror, which is fixed and large enough to reflect a full beam passing through the

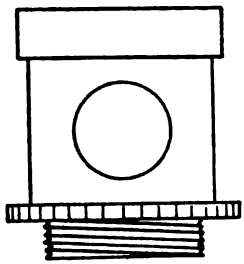


Fig. 49.

hole, $\frac{1}{2}$ in. in diameter, in the nose-piece. The strip of holes (fig. 50) is a drawing, in plan, of a tube, which fits over the narrow part of the nose-piece, and which is capable of rotation. The square aperture is $\frac{1}{2}$ in., and the circular holes are $\frac{4}{10}$ in., $\frac{3}{10}$ in., and

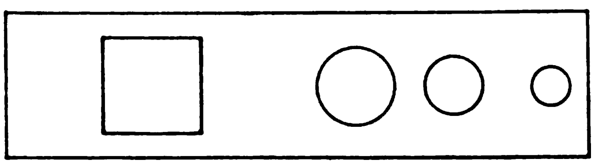


Fig. 50.

$\frac{2}{10}$ in. in diameter. The distances of the centres of the large and small circular holes from the edges of the square hole are $\frac{8}{10}$ in. and $\frac{7}{10}$ in., respectively; and the centre of the intermediate sized hole is $\frac{1}{2}$ in from the others; therefore the circumference of the tube, which is $\frac{1}{32}$ in. thick, is 3 inches, outside measure, so it fits

over the narrow part of the nose-piece, which is 0·935 in. in diameter.

A spring click (not shown) is provided to indicate when the centre of a hole is in the centre of the aperture in the nose-piece. The square aperture is for the purpose of rendering the illumination oblique. With a vertical illuminator minute graduations in the size of the aperture produce little, if any, effect in the image, therefore an iris diaphragm is unnecessary, but the examination of objects under oblique illumination is often of great importance; with the ordinary kind of vertical illuminator no provision is made for doing this. In this instrument it is only necessary to rotate the tube so that one edge of the square aperture should come over the hole in the nose-piece.

NOTE.

An Astronomical Eye-piece used as a Simple Microscope.

By E. M. Nelson.

Several Fellows of this Society are also interested in astronomy, and possibly use the beautiful Zeiss orthoscopic eye-pieces in their telescopes; but they may not be aware that these eye-pieces, when used upside down, i.e. with the eye-lens next the object, make excellent lenses for a simple Microscope, or loup, as it is now called. Finer pictures of a blow-fly's tongue than those seen with 12½ and 9 mm. orthoscopic eye-pieces cannot be obtained. The focusing tube, when taken out of my telescope, just happens to fit the 6-power Zeiss-Steinheil lens-holder of Paul Meyer's dissecting stand. By using the 5 mm. orthoscopic eye-piece as an object-glass, and by placing the 18 mm. orthoscopic eye-piece in the other end for an eye-piece, a compound Microscope of some considerable power is improvised. This will show Grayson's 20,000-band quite easily, and with a little movement of the concave mirror the 25,000-band can be readily seen. It will also show the exclamation marks on the *Podura* scale, and it will resolve a coarse *Navicula lyra*. This is, of course, only a plaything, but these eye-pieces, when used as loups in the manner indicated, give really very fine images. The powers are—

18 mm. . .	×13	9 mm. . .	×27
12½ " . .	×19	5 " . .	×50

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Action of Diluted Sea-water on Frogs' Ova and Larvæ.‡—G. Bohn and A. Drzewina find that small doses of diluted sea-water have an excitatory influence on the hatching of frogs' ova and on the growth of the embryos and larvæ. Above and below the optimum, monstrosities result. Solutions of NaCl, 5 parts in 1000, have a very marked inhibitory influence on the hatching and on the growth of the embryos, but much weaker doses seem to excite. Solutions of KCl, unless in very weak doses, proved extremely toxic. These are, however, but a few results of the extended and precise experiments.

Action of Radium Emanation on Development of Frogs.§—P. Wintrebert finds that a very weak dose of radium, similar to that in the radio-active thermal water of Plombières, has a favourable influence on the development and metamorphosis of frogs, especially during the growing period.

Studies on Chromatin Maturation of Sex Cells.‖—A. and K. E. Schreiner have studied the maturation of the male sex cells in *Tomopteris onisciformis*. The first maturation division is heterotypic; it separates conjugated chromosomes from one another, and is, accordingly, a reduction division. The second maturation division is homotypic; in it single chromosomes are longitudinally divided. It is, therefore, an

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Bull. Internat. Acad. Sci. Cracovie, 1906, pp. 293–314.

§ Comptes Rendus, cxliii. (1906) pp. 1259–62.

‖ Arch. de Biol., xxii. (1905) pp. 1–69 (3 pls.).

equation division. The phenomena observed in *Tomopteris* are regarded as fundamentally typical of the chromosome maturation of sex cells in both animals and plants in general.

On Heterochromosomes.* — S. Gutherz gives an account of the various types of heterochromosomes referred to in recent literature, with a particular description of those occurring in the sex cells in *Gryllus domesticus* and *Pyrrhocoris apterus*. In the former, in spermatogenesis, there is a heterochromosome of the monosome type with heterokinesis I, which in the spermogonia is distinguished from the twenty usual chromosomes by its special size and shape. In the male somatic mitosis there occurs no such element. In the first maturation mitosis the half spindle fibres attach to the ordinary chromosomes; the monosome undergoing heterokinesis receives no such fibres.

Interstitial Gland of Ovary.†—J. Bergonié and L. Tribondeau find that under the X-rays the ovary of the rabbit undergoes a diminution of volume. This is due to the atrophy of the interstitial gland, whose constituent nodules become separated, and whose cellular elements undergo shrinkage.

Action of Corpus Luteum Extract.‡—Lambert has submitted frogs and rabbits to various injections of corpus luteum extract of the sow and cow, with highly toxic results. There is a clear analogy between the action of extracts of glands of internal secretion and those of the corpus luteum: the latter, however, exhibits the highest toxicity of all.

Experimental Degeneration of Seminal Gland in Mammals.§—P Ancel and F. Villemin find that ablation of the parietal layer of the vaginale results in the degeneration of the seminal gland, whilst the morphological and functional integrity of the interstitial gland is undisturbed.

Tooth-development in Ornithorhynchus. ‖— J. T. Wilson and J. P. Hill have studied two specimens of mammary fœtus of the duckmole. The facts set forth seem to establish the existence of teeth belonging to at least two dentitional series. In the series to which the multicuspidate teeth of the adolescent animal belong there are probably five members. Besides these there seems to be a "nodular series—vestigial deciduous predecessors of the large molar teeth, much simpler in nature, each on the whole corresponding with one of the cusps of their multicuspidate molariform successors. But the early differentiation of nodules is not entirely confined to the region to be occupied by molar cusps. The relation of the two series in the molar region cannot but be regarded as suggestive of some sort of phylogenetic substitution of a small number of compound teeth for a large number of simple teeth—a process which must be reckoned as covering the fundamental idea of concrescence.

* Arch. Mikr. Anat., lxix. (1907) pp. 491–514 (12 figs.).
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 274–7.
‡ Tom. cit., pp. 18–20. § Tom. cit., pp. 6–8.
‖ Quart. Journ. Micr. Sci., li. (1907) pp. 137–65 (3 pls.).

Development of the Middle Ear in Emys europæa.*—Noack gives an account of the conditions observed in several embryonic stages of the middle ear in this tortoise. In particular he has investigated the question of the origin of the columella auris, and has failed to establish any connection of the columella blastema with that of the hyoid arch. He consequently denies to it any hyal origin.

Nasal Skeleton of Amblystoma punctatum.†—R. J. Terry gives an account of the structure and development of the nasal skeleton. We can only quote the last paragraph of the paper: "In *Amblystoma* the cartilaginous nasal capsule does not arise independently of the brain-case. It is from the beginning a part of the ethmoidal skeleton which is built in connection with the trabeculæ, ethmoidal columns and antorbital processes. In the development of the cartilaginous ethmoidal skeleton, there are formed, *pari passu*, a capsular covering for the epithelium of the nasal sac and protecting walls for the olfactory bulb."

Phagocytosis of Metamorphosis.‡—L. Mercier has studied this in Anura and in the Muscidæ. We quote only his conclusions on the role of the leucocytes in the degeneration of muscle fibres. The active participation of the leucocytes in such degeneration is established. As long as histolysis of the fibres is evident they do not appear. The sarcoplasm becomes vacuolar, the nuclei show chromatolytic degeneration, and the fibres break at their extremities. Until this stage the sarcolemma remains intact. The phagocytary process consists of: (*a*) the phase of isolation: the leucocytes form a real sheath round the degenerating fibres. (*b*) The penetration of the leucocytes. This has as an immediate result the agglutination of the fibrils which form a homogeneous layer. Out of this the leucocytes cut pieces, suggestive of punched holes. (*c*) Fragmentation of the fibres into sarcolytes, which are enveloped and digested by the leucocytes. Other points discussed in this exhaustive memoir are the development of the leucocytes, the degeneration of the caudal epidermis in the Anura (*Rana temporaria*), experimental phagocytosis, etc.

Amitosis as a Factor in Normal and Regulatory Growth.§—C. M. Child communicates facts suggesting that amitosis is of frequent occurrence in the normal development of many forms. Examples are given from *Tubularia mesembryanthemum*, *Corymorpha palma*, *Planaria maculata*, various Cestodes, Annelids, and Chordates. It is evidently not the rare and exceptional process which it has been supposed to be, although it is possible that the term may be found to include a variety of nuclear phenomena depending on quantitatively and perhaps qualitatively different conditions and leading to different results. The most characteristic feature in all cases of amitosis described is the apparently non-cyclical or orthodromic character of the processes involved, as far as the nuclear contents are concerned. These processes appear to consist

* Arch. Mikr. Anat., lxix. (1907) pp. 457–90 (1 pl. and 6 figs.).
† Trans. Acad. Sci. St. Louis, xvi. (1906) pp. 95–124 (4 pls.).
‡ Arch. Zool. Expér. et Gén., sér. 4, v. (1906) pp. 1–151 (4 pls.).
§ Anat. Anzeig., xxx. (1907) pp. 271–97 (12 figs.).

essentially in the continued production of new nuclear material like that already present, and without the periodical recurrence of metamorphosis. The act of division itself is very probably a mere physical incident of the increasing volume of substance. Mitosis on the other hand is very evidently associated with cyclical processes in the nucleus, for alternate departure from and return to certain conditions are characteristic features. The author deals with the hypothesis of "chromosome-individuality," which he regards as very improbable as a universal hypothesis.

Development of Polypterus.*—J. Graham Kerr gives a short account of some of his observations on the development of *Polypterus senegalus* from the Niger. The buccal cavity is from the beginning widely open; the secretory epithelium of the cement organs is endodermic in origin, arising as a pair of diverticula from the anterior end of the gut, like gill-pouches; the lung rudiment is at first median and ventral; the pancreas arises from three diverticula; the "liver" is really a hepatopancreas. The author gives a short account of the development of the kidney and the vascular system, and makes some notes on the early skull which has some resemblances to that of Amphibia. The cavity of the dorsal aorta is formed by the fusion of vacuoles in masses of protoplasm derived from the sclerotomes. The endocardium is apparently mesodermic in origin. It is suggested that the blood corpuscles are mesodermic cells set free from their neighbours by the drawing in of cell processes accompanying an epidemic of mitosis. During a prolonged period only one pair of aortic arches is present—those of the external gills (hyoidean).

Regeneration of the Lens in Amphibians.†—Hans Spemann makes some new contributions to this interesting subject. In *Rana esculenta* the lens may develop without any stimulus on the part of the optic vesicle. The primordium of the retina in the medullary plate was excised with a glass needle, yet sections showed on the eyeless side the rudiment of a lens or a well-formed lens with fibres. But in *Rana fusca* similar experiments had a negative result. Some other very remarkable experiments are recorded.

Agenesis of the Vermiform Appendix.‡— H. T. Marshall and R. T. Edwards describe a case in which there was no appendix visible on external examination of the cæcum. Microscopical examination showed only a rudimentary structure, which extended as a shallow invagination of the mucosa of the cæcum from its lumen, ending between the fibres of the circular muscle of the cæcum.

Histogenesis of the Retina.§—A. W. Weysse and W. S. Burgess have studied the development of the retina in the chick. It consists at first of a syncytium. Most of the nuclei eventually go to form the ganglion-cell layer; those next the external limiting membrane become

* Proc. R. Phys. Soc. Edinburgh, xvii. (1907) pp. 73–5.
† Zool. Anzeig., xxxi. (1907) pp. 379–86.
‡ Philippine Journ. Sci., i. No. 10 (1906) pp. 1061–5 (3 pls.).
§ Amer. Naturalist, xl. (1906) pp. 611–37 (17 figs.).

the germinal nuclei. Only the row of germinal nuclei has the power of division.

There are three well-defined periods of growth: (*a*) the period of cell-multiplication (second to eighth day); (*b*) the period of re-adjustment (eighth to tenth day); (*c*) the period of final differentiation (tenth day to the end of the incubation). Up to the end of the first period the retina grows from within outward by the deposition of an additional row of nuclei with each successive generation. After this, karyokinetic figures are found only at the margins.

Differentiation begins at the centre of the retinal cup, and spreads towards the growing margins. The nearer the margin the younger are the stages seen. The ganglion-cell layer consists at first of three rows of nuclei; these fall into line in the direction of the internal limiting membrane, so as eventually to form but one layer.

In the inner nuclear layer, differentiation into horizontal cells, fibres of Müller, and bipolar cells takes place *pari passu* with the formation of these nuclei. This layer consists at first of about fourteen generations of nuclei. With the exception of the horizontal cells, each successive generation fails to attain quite the size of the one preceding. The number of rows of nuclei decreases from fourteen to eight by a closing up of the ranks in the direction of the external limiting membrane.

Up to the end of the period of re-adjustment, the nuclei of the inner nuclear layer are elliptical in outline, with the long axis at right angles to the external limiting membrane. Later they become circular. The reticular layers are cytoplasmic in both origin and structure.

The pigment layer is a direct continuation of the retina, and, like it, begins as a syncytium. The nuclei, at first in two rows, are soon arranged in one, with the stretching out of the surface area. Active growth is restricted to the margins of the pigment layers, and continues as long as the eye increases in size. The nuclei remain of the same size as those in the early undifferentiated condition. Pigment granules first form on the side of the layer away from the retina and in the protoplasm between the nuclei. They are never normally found outside the cytoplasm of the pigment-cell, and there is no evidence that pigment is a food-substance. The numerous large blood-vessels in the choroid coat next the pigment layer may furnish the nutritive material for the development of the retina.

The outer nuclear layer represents the last two generations from the division of the germinal nuclei. The rod nuclei are the youngest in the retina. They are more numerous than the cone nuclei, and division among them does not wholly cease until the rods of their immediate neighbours have attained a high degree of development. The rods and cones have their origin in undifferentiated cytoplasm, and there is no evidence that any part of the rod or cone is of nuclear origin. The nuclei of the rods and cones retain their early position wholly within the external limiting membrane, and are not protruded beyond it, as has been recorded for other animals. In the development of the retina there is no fixed time for the appearance of the different elements.

Origin of Lung in Ceratodus.*—Greil points out that between the seventh and last of the branchial outgrowths of the gullet and the

* Anat Anzeig., xxix. (1906) Ergänzungsheft, pp. 115–31.

lung rudiment there occurs a considerable space. The lung rudiment in *Ceratodus* is an unpaired outgrowth of the ventral wall of the gut close to and on the right side of the median plane. It is quite distinct from the relatively short gullet pockets occurring in the lateral wall, and cannot be regarded as arising from gill pouches.

Parental Care in Lophobranchs.*—Max Petersen has studied the brood-pouch in *Nerophis ophidion* and *Siphonostoma typhle*. In the former the eggs are found firmly attached in 2–3 longitudinal rows on the ventral surface of the male, between the gills and the anus. They are attached by a layer of mucus, which seems to be produced by the epithelial cells of the male. Some eggs removed from their attachment failed to develop, but there is no definite evidence that the attachment has any respiratory or nutritive significance. The egg-laying in *Nerophis* begins in the first half of May, and ends in July.

In *Siphonostoma*, the pouch begins to be formed (at Greifswald) early in May; the eggs are liberated from the last third of May to the middle of June; most of the embryos hatch in July. The retrogressive changes in the pouch are completed by about the middle of October. A series of stages showing the development of the pouch from two folds of the integument is carefully described. The author believes that the seminal fluid liberated into the water finds its way into the pouch where fertilisation takes place. But his observations are not conclusive. After fertilisation the margins of the pouch-valves are apposed, and the pouch is shut, and there is a peculiar internal folding of the epithelium. The pouch consists of (1) the external epithelium; (2) a two-layered stratum of connective tissue with numerous blood-vessels; and (3) an internal epithelium. In the filled pouch there are noteworthy changes in the two inner layers. There must be diffusion of oxygen from the paternal blood-vessels to the inclosed eggs, and Petersen thinks that there is also a nutritive connection. In the retrogressive changes which lead to the disappearance of the pouch, phagocytes play an important if not an exclusive role.

Effect of Radium on Scyllium embryos.†—Jan Tur has experimented with embryos of *Scyllium canicula*, and finds that radium salts exert what he terms a local and "teratogenetic electivity." They provoked in every case identical malformations, which were confined to axial parts. Longitudinal growth was arrested. The nervous system underwent involution, becoming a simple ectodermic plate which consisted of a mass of rounded cells whose protoplasm showed necrotic disintegration. The blastoderm outside the embryo remained normal; radium effects were most marked on embryonic elements poor in vitellus.

Text-Book of Teratology.‡—Ernst Schwalbe has completed the second part of his morphology of abnormalities in man and animals. It deals with the various forms of duplicities in development.

* Zool. Jahrb., xxiv. (1906) pp. 265–306 (1 pl. and 15 figs.).
† Arch. Zool. Exper., Notes et Revue, No. 2, xxxv. (1906) pp. xxxix.–xlviii. (6 figs.),
‡ Die Morphologie der Missbildungen des Menschen und der Tiere. II. Teil. Die Doppelbildungen. Jena, 1907, 2 pls. and 394 figs. See also Anat. Anzeig., xxx. (1907) pp. 31–2.

Heredity and Variation.*—W. K. Brooks points out that living beings do not exhibit unity and diversity, but unity in diversity. These are not two facts, but one. Inheritance or resemblance to ancestors, and variation or difference from ancestors, are only imperfect mental concepts—crude ideas, and not facts; the fact is the individuality in kinship of living beings. But if resemblance to ancestors does not exist in nature separated from individuality or difference from ancestors, what becomes of the notion of a substance of inheritance? To speak of such seems to Brooks a fallacy. The species is not in chromatin, nor in germ-cells, nor in gemmules, nor in biophors, nor in allelomorphs, nor in living beings: it is in that reciprocal interaction between the living being and the natural world, of which it is a part, which has been called the struggle for existence. The being of the individual organism is not in itself, but in the reciprocal interaction between it and its environment. "Is it not time to have done, once and for all, with the metaphysical, pre-Darwinian notion of species, as something that resides in germ-cells, and is handed down by a substance of heredity?"

b. Histology.

Origin of the Centrosome.†—J. Kunstler maintains that the centrosome is the primitive cellular centre. It is due to a specialisation of an ordinary plasmic spherule. "It seems to have preceded the nucleus as an intracellular morphological element. Its role seems to have remained essentially reproductive." Just as some cells have several nuclei, so some have several centrosomes.

Intercellular Connections of Epithelial Cells in the Intestine.‡—R. Weigl finds clear evidence of intercellular bridges between epithelial cells in the intestine of the newt, *Proteus* and *Spelerpes*. He finds that the bridges contain prolongations of the endoplasm, and believes that they may serve for the transmission of stimulus.

Elastic Tissue.§—Ed. Retterer has studied the elastic tissue in the cervical ligament and in the aorta of the dog, cat, guinea-pig, and horse. The origin of elastic structures is entirely cellular. The coalesced cells have a homogeneous cytoplasm. In the cervical ligament the peripheral cytoplasm forms elastic fibrils, and the number may be added to from within at the expense of the clear cytoplasm around the nucleus. In the aorta the cells that form the elastic fibres and lamellæ are spindle-shaped and disposed like epithelium. They have been described as smooth muscle-cells. The peripheral cytoplasm is differentiated into elastic fibrils disposed in zones or lamellæ arranged concentrically around the lumen of the vessel. As a cell is differentiated peripherally, the perinuclear zone is reduced and the nucleus is much modified, gradually showing the characters of elastin. The position of the cell-residues is indicated by clear spaces in the elastic lamellæ—the alleged pores of fenestrated membranes.

* Proc. Amer. Phil. Soc., xlv. (1906) pp. 70–6.
† Comptes Rendus, cxliv. (1907) pp. 45–6.
‡ Bull. Internat. Acad. Sci. Cracovie, 1906, pp. 777–91 (1 pl.).
§ C.R. Soc. Biol. Paris, lxii. (1907) pp. 56–8.

Elastic Tissue in Eye of Birds.*—E. Wace Carlier has studied this in a large number of birds. Among Vertebrates, the Sauropsida alone possess striped muscle fibres within the eyeball, which, by their powerful and rapid contraction, permit of a sudden change from negative to positive accommodation. The shock which might be imparted to the delicate structures within the globe, might interfere with clearness of definition, were not some means provided of absorbing it, and of converting the sudden pull of the muscle on the choroid into an even, continuous strain. This is effected by a great increase in the amount of elastic tissue within the eye. When compared with the eyes of other Vertebrates, the eye of a bird is seen to contain an enormous quantity of elastic fibres, and to be provided with a special elastic tendon for the insertion of the ciliary muscle; this is present to some extent in lizards, but no trace of such an arrangement can be found in fishes, amphibians, or mammals. There is elastic tissue in the membrane of Descemet, the pectinate ligaments, the ciliary ground plate, the choroid, and the sclerotic, and of all this details are given.

Kidney of Gobiésocidæ.†—F. Guitel gives a detailed account of the structure of the kidney in this family. Under External Anatomy are described the general conformation, the large arterial and venous trunks, and the relation of the pronephros and mesonephros to the skeleton. The leading points treated under Internal Anatomy are the structure of the pro- and mesonephros, the suprarenal capsules, urinary papillæ, and calculi. Nine species, representing five genera, are dealt with, and in several instances both male and female types are separately considered.

Minute Structure of the Electric Organ of Mormyrus oxyrhynchus.‡—H. Schlichter gives a full account of the electric plate, or electro-plax, in this fish, discussing the inner fibrillar layer, the cortical substance, the plate-processes, the rod-structures, the gelatinous substance of the chambers and the included blood-vessels, the nerves, and the nerve-endings.

Hearing Organ in Petromyzon.§—R. Krause describes the histology and relations of the ductus endolymphaticus, which is paired. A homologising of the nerve-endings with those of the other Vertebrates appears impossible at present. The labyrinth possesses, like that of Elasmobranchs and Teleosteans, seven nerve-end regions, and two cristæ acusticæ in the anterior and posterior ampullæ; one macula in the mesial side division of the anterior and posterior ampullæ; a papilla in the sac-shaped appendage; a macula in the so-called sacculus; and finally, a papilla in the dorsal duct. The homologies of these various structures are indicated.

c. General.

Gas-gland in Teleostean Fishes.‖—Caroline Reis has studied this organ in *Macropodus*, *Syngnathus*, *Girardinus*, *Trigla*, *Sargus*, and many

* Proc. Scottish Micr. Soc., iv. (1906) pp. 70–92 (4 pls.).
† Arch. Zool. Expér., 4 sér., xxxv. (1906) No. 5, pp. 505–698 (5 pls. and 34 figs.)
‡ Zeitschr. wiss. Zool., lxxxiv. (1906) pp. 479–525 (3 pls.).
§ Anat. Anzeig., xxix. (1906) Ergänzungsheft, pp. 257–65 (4 figs.).
‖ Bull. Internat. Acad. Sci. Cracovie, 1906, pp. 771–7.

other forms. It varies greatly in extent and shape, but the horse-shoe shape is typical. It consists chiefly of capillaries (from the cœliac) and an epithelial tissue in one layer or in several layers. In many cases there are tubular diverticula or ramifications of the epithelial layer. The form of the efferent ducts is very variable. Gas bubbles are formed inside the cells by fragmentation of the nucleus and simultaneous granular degeneration of the cytoplasm.

Parietal Sense-organs of New Zealand Lamprey.*—Arthur Dendy gives an account of the organs in the "Velasia" stage of *Geotria australis*. After describing the fore-brain and its derivatives in general, he discusses the pineal organ (right parietal eye), the pineal nerve and its connections, the parapineal organ (left parietal eye) and its relations to the brain, and the accessory structures overlying the parietal sense-organs.

The evidence derived from the study of *Geotria* may be summarised as follows :—

1. The parapineal organ, in its position to the left of the pineal, still shows evidence of its primitive paired character.

2. The structure of the pineal and parapineal organs is essentially identical, although the former is much more highly developed than the latter.

3. The connection of each of the two sense-organs with the corresponding member of the habenular ganglion pair need no longer be questioned.

4. The marked asymmetry in point of size of the two habenular ganglia, and of the two bundles of Meynert corresponds exactly to the unequal development of the two parietal sense-organs with which they are connected, and leaves no doubt as to the paired character of the whole system.

Caudal Circulation and Lymph-hearts in Amphibia.†—G. Favaro gives a detailed account of the caudal circulation in the newt, salamander, *Proteus* and other Urodela, and in the larvæ of *Hyla arborea* and *Bufo vulgaris*.

Artificial Growths.‡—Stéphane Leduc describes artificial growths produced in saccharine media by the addition of KCl, NaCl, KNO_3, NH_4Cl, etc. The growth is characteristic in given conditions. There may be roots, stem, and terminal organs ; they are stable and transportable ; there is metabolism and nutrition and circulation ; grafting is possible. Analogies with organic growth are unmistakable.

Leduc's Artificial Organisms.§—Charrin and Goupil have experimented with Leduc's artificial organisms made out of sulphate of copper and syrup of sugar, and find that there is no evidence of assimilating power, e.g. of utilising sugar.

* Quart. Journ. Micr. Sci., li. (1907) pp. 1–29 (2 pls.).
† Atti Accad. Sci. Veneto-Trentino-Istriana, iii. (1906) pp. 122–66 (20 figs.).
‡ Comptes Rendus, cxliv. (1907) pp. 39–41 (2 figs.).
§ Tom. cit., pp. 136–7.

Persistent Craniopharyngeal Canal in Homo.* — Otto Schlaginhaufen found in the skull of an adult female semang from the Malay Archipelago, a persistent craniopharyngeal canal—a very rare arrest of development. The canal remains open in a certain percentage of anthropoid skulls, e.g. 24·25 p.c. in the orang; 43·4 p.c. in the gorilla; 66·6 p.c. in the chimpanzee.

Structure of the Gorilla.†—W. Kükenthal points out that, owing to lack of good material, our anatomical knowledge of the gorilla has lagged behind our knowledge of the other anthropoid apes. He has set himself to remedy this defect, and we have an account of the eye by Heine, of the lingual papillæ by H. Stahr, of the female urogenital system by U. Gerhardt, and a note on the animal's life and habits by F. Grabowsky.

Cerebellum of Mammals.‡—Louis Bolk has published as a volume three studies on the comparative anatomy of the cerebellum of Mammals, which originally appeared in "Petrus Camper." It will prove a useful guide to the study of a part of the brain which merits more attention than it has hitherto received—from the comparative anatomist's point of view at least—and a supplement to the recent investigations of Elliot Smith and Charnock Bradley.

Ciliary Ganglion of Carnivores.§—T. M. Lecco has studied various Carnivores, e.g. cat and dog, and finds that the ciliary ganglion includes two ganglia, *majus* and *minus*. The *ganglion ciliare majus* is in very close association with the oculomotor nerve; the *ganglion ciliare minus* seems to be dependent on certain nerve bundles, which form the *radix longa*. This *radix longa* includes three sets of nerve-fibres. One set behaves like the nerve-bundles of the ciliary nerves; the second seems to enter into relations with the *G. ciliare minus*; the third is connected with the *G. ciliare majus*, and is, perhaps, identical with the *radix recurrens* in man.

Black-and-tan Pattern of Domestic Dogs.‖ — R. I. Pocock points out that if a dog with this pattern be compared with many of the common wild species of Canidæ, it will be seen that the tan occurs over areas which in the wild species are paler than the rest of the body, owing to the fading or absence of the black annuli which prevail in the hair elsewhere, and that the black corresponds to the darker portions of the body, where the hair is richly pigmented, in the wild animals. This statement only needs qualification with respect to the tan spots over the eyes, the homologues of which are by no means always visible in wild dogs, or, at all events, are not sufficiently evident to carry absolute conviction as to their presence.

Black-and-tan dogs may be termed melanescent, or, preferably, nigrescent sports. The tan stands in the same relation to the pale

* Anat. Anzeig., xxx. (1907) pp. 1–8 (5 figs.).
† Jen. Zeitschr. Naturw., xli. (1906) pp. 607–54 (3 pls. and 17 figs.).
‡ Das Cerebellum der Säugetiere, Jena, 1906, 337 pp., 3 pls. and 183 figs.
§ Jen. Zeitschr. Naturw., xli. (1906) pp. 483–504 (18 figs.).
‖ Ann. Nat. Hist., xix. (1907) pp. 192–4.

areas as the black does to the more heavily pigmented areas of the wild species; and it is a highly interesting fact that the nigrescent sport throws back to the type of pattern characteristic of a parent form. Tan is merely one of the shades of that class of colour which is called "erythristic," and it appears that albinism, erythrism, and melanism are three consecutive stages in colour-variation, erythrism being the incipient stage either of albinism or melanism.

Law of Fatigue in Racing.*—A. E. Kenelly finds from the records of trotting, racing, and running horses, as well as from those of running, walking, rowing, skating, and swimming men, that the time varies approximately as the ninth power of the eighth root of the distance. Doubling the distance means increasing the time 118 p.c. The time occupied in a record-making race varies approximately inversely as the ninth power of the speed over the course. Doubling the speed cuts down the racing time 512 times. The distance covered increases approximately as the eighth power of the ninth root of the time. Doubling the time of the race allows of increasing the course length by 85 p.c. The distance covered increases approximately as the inverse eighth power of the speed over the course. Doubling the speed cuts down the distance that can be covered 256 times. The speed over the course varies approximately as the inverse eighth root of the distance. Doubling the distance brings down the speed about 9·3 p.c. The speed over the course varies approximately as the ninth root of the racing time. All these statements are different aspects of one and the same fact.

"If any of the three qualities, L, T, and V $(= \frac{L}{T})$, be plotted on logarithm paper as ordinates to either of the other qualities as abscissæ, the record points will fall on, or near to, a straight line."

"Athletes aspiring to break racing records might succeed better in attacking those whose points fall below the straight lines of speed against distance, or above the straight lines of time against distance, rather than those whose points fall on the opposite sides of those lines."

With the exception of bicycling, the law of fatigue in racing is the same or very nearly the same for horses and for men.

Habits of Fierasfer affinis.†—E. Linton gives an interesting account of the behaviour of this *Fierasfer* when forced to leave the body of its host, *Stichopus mœbii*. When the Holothurian is kept for a short time under a finger-bowl so as to produce partial asphyxiation, *Fierasfer* leaves the body of its associate and swims excitedly near the surface of the water, taking in gulps of air. Its sense of sight appeared defective, but this was not proved. Apparently by accident it touches the body of the Holothurian with its snout; immediately it feels its way backward to the posterior end without pause or regression, as if following a scent. Instantly on touching the cloacal opening, the slender tail is brought round with a very rapid whip-like movement, which terminates in a thrust whereby the tip is inserted. Up to this point the fish is excited; it now leisurely insinuates its body into the host.

* Proc. Amer. Acad., xlii. (1906) pp. 275–331 (18 tables).
† Amer. Naturalist, xli. (1907) pp. 1–4 (2 figs.)

Pennsylvania Fishes.*—Henry W. Fowler gives records of the fishes known to occur in the State of Pennsylvania. The special feature of the records is that they note the distribution of the species in the various lakes, streams, etc., throughout the State, and for some localities the notes are regarded as practically complete.

Lacustrine Deep-water Fauna.†—F. Zschokke discusses the fauna of the depths of the Vierwaldstättersee. From depths of 170–214 metres he obtained 100 species, including (*a*) littoral forms, which have migrated downwards, and (*b*) genuine abyssal forms which represent relicts of a stenothermal post-glacial fauna.

Marine Zoological Laboratories.‡—P. Francotte gives an interesting illustrated account of the marine zoological laboratories at Naples, Roscoff, Banyuls, Concarneau, and Villefranche. He traces their history, and points out the special facilities which they severally afford. He states that it was P. J. van Beneden who established the first laboratory of marine zoology (1842).

Effect of the Eruption of Vesuvius on Marine Fauna.§—Salvatore Lo Bianco gives an interesting account of the effects of the showers of ashes from the 1906 eruption of Vesuvius on the marine fauna of the Gulf of Naples. Many animals were killed, the plankton was much affected, the distribution of certain forms was altered, autotomy was observed in hydroids, *Antedon* and Tunicates; in some cases, e.g. *Polymnia nebulosa* and *Aricia fœtida*, the liberation of ova was retarded.

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Phylliroë.‖—N. Vessichelli has made a study of *Phylliroë bucephala* Péron and Lesueur, with especial reference to the nervous system, the rudiment of the foot, the cutaneous glands, and the digestive organs. The family Phylliroidæ includes *Phylliroë bucephala*, *Ph. atlantica*, *Ctilopsis picteti*, *Acura lanceolata*, and *A. pelagica*.

Composition and Development of the Radula.¶—Igerna B. J. Sollas has studied this in *Patella*, *Cryptobranchia*, *Acmæa*, *Lepeta*, *Trochus*, *Littorina*, *Buccinum*, *Helix*, and other forms. She finds that in all the odontophorous mollusca the radula has an organic basis of chitin. The Docoglossa are unique in the composition of their teeth, of which the most important constituent is silica hydrate or opal. All the other groups, including the Rhipidoglossa, form a second type in which the radular chitin is hardened superficially by deposits containing calcium,

* Amer. Naturalist, xli. (1907) pp. 5-21 (1 fig.).
† Arch. Hydrobiol. Planctonkunde, ii. (1906) heft 1, pp. 1–8. See also Zool. Zentralbl., xiii. (1906) pp. 551-2.
‡ Ann. Soc. Belge Microscopie, xxviii. (1907) pp. 1–44 (15 figs.).
§ MT. Zool. Stat. Neapel, xviii. (1906) pp. 73–104.
‖ Tom. cit., pp. 105–35 (2 pls.).
¶ Quart. Journ. Micr. Sci., li. (1907) pp. 115-36 (1 pl.).

iron, and phosphoric acid, which, together perhaps with an additional organic substance, form that outer covering so long known as the enamel layer, but hitherto unexplained. The Chitonidæ are peculiar in having ferric oxide as the most important mineral constituent of their dark-coloured teeth.

In the Docoglossa the mineral matter may be 27 p.c. of the whole ribbon, as in *Patella vulgata*. In the others it may contribute only 2·4 p.c. as in *Helix aspersa*, though in this species it sometimes rises to 3·3 p.c.

It seems most probable that the odontoblasts are replaced by fresh cells derived from the cell aggregate at the extremity of the radular sac. Starting from the indifferent cell mass from which they arise by cell division, the odontoblasts become elongated and form a set of cells which possess as a whole a definite and constant shape. They secrete chitin first for the teeth, next for the basal membrane, and are then described as exhausted. But they pass on and become the youngest cells of the basal epithelium. They then travel forwards, adhering to the basal membrane, and become gradually shorter. As they continue their course they encounter the superior tensor muscle, and they have to adhere to the radular membrane on the one hand, and make connection with the tensor muscle on the other. They become liberated from the muscle again and pass forward, now as a low epithelium, until they encounter the inferior tensor, with which some become connected. After this they once more move forwards to form part of the walls of the sublingual groove which is the natural outcome of the mode of growth of the radula, and which allows of the free play of the buccal cartilages in eating.

Reproduction of Arion empiricorum.*—H. Lams communicates some notes on the sexual functions in *Arion*. The animals are protandrous, ovarian development occurring from September to November. Fertilisation is reciprocal, and takes place at the end of the male period while the eggs are immature; it is often intra-ovarian, and eggs may be found in the morula and blastula stages in the interior of the ovary, although this is not usual.

δ. Lamellibranchiata.

Glandular Organ in Pinna.†—Mario Stenta gives a full account of a pre-oral tubular gland in *Pinna*, which he calls Poli's gland. It is probably excretory in function, and opens by a lateral duct into the infra-branchial cavity. It produces a fluid secretion, and may take the place of the pericardial gland which is absent in *Pinna*.

Fluorine in Shells of Bivalves.‡—P. Carles has shown the presence of fluorine (obtained from terrestrial fluorides in the sea-water) in small percentage (0·012) in the shells of oysters and mussels.

Radiography applied to Discovery of Pearls.§—R. Dubois points out that in 1901 he submitted radiographs of a pearl inside *Margaritana*

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 255–7.
† Arbeit. Zool. Inst. Univ. Wien, xvi. (1906) pp. 407–36 (1 pl. and 1 fig.).
‡ Comptes Rendus, cxliv. (1907) pp. 437–8.
§ C.R. Soc. Biol. Paris, lxii. (1907) pp. 54–5 (1 fig.).

margaritifera Dupuy. At the Colonial Exhibition at Marseilles, in 1906, Auguste Lumière, at the request of Dubois, made and exhibited a fine radiograph of a pearl in a valve of *Margaritifera vulgaris* Jameson.

Arthropoda.

α. Insecta.

Fertilisation in Nematus ribesii.*—L. Doncaster has studied the gametogenesis and fertilisation of this sawfly. True fertilisation (conjugation of male and female pronuclei) may occur, and the behaviour of the polar nuclei is slightly different in fertilised and virgin eggs. In the spermatogenesis there are eight chromosomes in spermatogonial divisions; four "gemini" appear at the beginning of the maiotic phase, and by heterotype and homotype mitoses distribute four chromosomes to each spermatid. In the oogenesis eight chromosomes appear in oogonial mitoses, but in divisions of nuclei in the ovary sheath more than eight are found, suggesting that the chromosomes of the germ-cells are compound.

In the polar mitoses of the egg two types of maturation are found. In some eggs there are successive equation divisions, so that the egg nucleus and each of the three polar nuclei contains eight chromosomes. In other eggs normal reduction takes place, separating entire chromosomes from one another, and only four are found in each of the daughter nuclei. It is probable that only such reduced eggs are capable of fertilisation, but when unfertilised they may continue to develop at least as far as the blastoderm stage.

Effect of Heat on Insect larvæ.†—J. Dewitz has experimented with lepidopterous and dipterous larvæ, and finds that the effect of heating is markedly injurious. Fairly low temperatures, e.g. 40° C., are sufficient in fifteen minutes to induce alterations in the organism manifested by changes in the colour of the blood. Even when exposed to such a temperature for forty minutes, the insect larvæ may recover, but their subsequent fate is somewhat uncertain. Since, in consequence of local conditions, larvæ are liable to warmth changes in summer analogous to those of the experiments, heat influence is to be regarded as underlying manifold modifications ("Abänderungen").

Histolysis without Phagocytosis.‡—Charles Janet recalls our attention to the musculature of flight in the queen ants—the biggest thing in the body—which functions only once in a lifetime of perhaps ten years. After the nuptial flight it disappears completely, and is replaced by little columns of adipocytes. A careful study of this degeneration in the queen of *Lasius niger* shows that the histolysis is accomplished without any intervention of phagocytes. Apparent leucocytes, which have begun in various parts of the body and at various stages to be transformed into adipocytes with albuminoid globules, have been mistaken in insects for phagocytes. The material of the muscle goes to enrich the blood.

* Quart. Journ. Micr. Sci. li. (1907) pp. 101–13 (1 pl.).
† Centralbl. Bakt. Parasitenk., 2te Abt., xvii. Nos. 1–2 (1906) pp. 40–53.
‡ Comptes Rendus, cxliv. (1907) pp. 393–6 (4 figs.).

Circulation in Insect Larvæ.*—A. Popovici-Baznosanu describes in the larva of *Chloe*, *Siphlurus*, and *Tricorythus* a ventral thoracic sinus identical with the abdominal sinus of Graber. The blood is passed from the sinus into the abdomen by the contractions of the ventral muscles.

Insect Bionomics.†—F. Merrifield discusses a number of factors affecting insect life. With a view to guiding inquiry and to rendering our knowledge more complete, he suggests consideration of the following propositions:—In the life-history of a species, the number of its offspring should be observed and recorded. The consumption by herbivorous insects of their food supply is not, except under special circumstances, a cause of the extinction or permanent reduction in numbers of a species. Mutual competition is not usually of primary importance in keeping down the numbers of a herbivorous species of insect: the chief factors are their active enemies. Insects, being endowed with nervous matter controlling or guiding their movements, are in their habits and activities affected by a psychic factor which must be taken into account. Observation and record of the abundance or scarcity of a species or variety, either generally or locally, and evidence of the processes by which the balance of organisms as affecting herbivorous insects is secured, are desirable. Factors which may have selection value are polymorphism, scarcity, habits, etc. On the other hand, a large number of conspicuous features, sufficient in themselves for selection, are not, in fact, selected, but persist irrespectively of it.

Natural Colour of Green Silk.‡—R. Dubois applies the name chloroyamamaïne to a crystallisable green substance which he isolated from the cocoons of *Saturnia Yama-mai*, and which is to be distinguished from an associated blue substance (cyanoyamamaïne). While Levrat and Conte regard the former as a chlorophyll, the opposite view is maintained by Villard.

Rectal Respiration in Simulium.§—E. Roubaud describes in the larvæ of *Simulium damnosum* in Central Africa exsertile rectal branchiæ, which he regards as supplementing the insufficient cutaneous respiration, and as a special adaptation to life in the water of warm countries.

An Interesting Muscid.‖—J. Künckel d'Herculais discusses *Anthomyia* (*Chortophila*) *cilicrura* Rondani (= *A. cana* Macquart, and *A, peshawarensis* Bigot), a minute Muscid which occurs in North America, Algeria, India, South America, in fact almost everywhere, and is most destructive of the ova of locusts and their allies in which the larvæ are parasitic. It turns out, however, that the larvæ are in certain conditions vegetarian, and are found attacking onions and the like, which accounts for the world-wide distribution.

Blastophaga and the Fig.¶—Leclerc du Sablon describes what happens when a *Blastophaga* lays an egg in figs of the third crop. The

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 20–1.
† Trans. Entom. Soc. London, 1906, pp. cxiii.-cxliii.
‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 52–4.
§ Comptes Rendus, cxliv. (1907) pp. 716–17.
‖ Tom. cit., pp. 390–3. ¶ Tom. cit., pp. 146–8.

egg of the insect takes the place of a seed within the ovary; it develops slowly and digests the albumen; there is parasitic castration. The albumen is formed parthenogenetically, the egg of the *Blastophaga* having the same stimulating effect as the pollen, and not only does it provoke the internal development of albumen, but it induces an external increase of the ovule.

Genital Appendages of Diptera.*—W. Wesché gives a detailed account of the genital appendages in representative Diptera, and comes to the conclusion that the external appendages of both extremities in Insecta are derived from two organs of the character of maxillæ, and that all the variations of the parts are adaptations of these organs.

The male genital appendages and the mouth-armature are on the same general plan, of a central perforated organ surrounded by aculeate and sensory (or possibly sensory) appendages. They coincide in many details of structure and arrangement. The male and female genital appendages are homologous. The male armature, the ovipositor, and the mouth-parts have a central mechanism (double apodemes, apodeme of ovipositor, fulcrum or submentum) which guides or governs the whole, or traces or remains of such a part.

We do not know why the author is not satisfied with the general conclusion that the external genital appendages have an appendicular, i.e., limb-like, nature, and are therefore serially homologous with oral appendages, or why he weakens his case by dragging in the intimate connection known to exist between the male genitalia and the throat, voice, and the hairy appendages of the mouth in the Mammalia.

Philippine Culicidæ.†—C. S. Banks gives an account of eighty-three species, sub-species, and varieties, including seven new species or varieties. These represent thirty genera in six sub-families. Of particular interest is the new sub-species, *Stegomyia fasciata persistans*, which differs from *S. fasciata*, Fabr. in the ornamentation of the mesothorax. The significance of the distinction, in view of the fact that *S. fasciata*, Fabr. is not certainly known in the islands, will be very great if it can be shown that the new sub-species is unable to convey the germs of yellow fever. The study of a series of bred specimens of *S. scutellaris samarensis*, Ludl., which exhibits many variations, has suggested a close relationship between *S. scutellaris* Walk. and *S. fasciata* Fabr., and that their true zoogeographical boundary line lies in the vicinity of the Philippines. A fuller discussion of this point is reserved for a future paper.

Notes on African Œstridæ.‡—K. Grünberg describes a new genus, *Tachinæstrus*, with a single species, *T. fenestratus*, from Sierra Leone. Only the imago is known; it may possibly belong to Brauer's larva, *Dermatæstrus strepsicerontis*. It is to be regarded as a synthetic type of the Tachinidæ, Muscidæ, and Œstridæ. From the skin of an African elephant is described a larva which forms the type of another genus,

* Trans. Linn. Soc. (Zool.), ix. (1906) pp. 339–86 (8 pls.).
† Philippine Journ. Sci., i. (1906) pp. 977-1005.
‡ SB. Ges. Nat. Freunde, Berlin, 1906, pp. 37–49 (7 figs.). See also Centralbl. Bakt. Parasitenk. Ref., xxxviii. Nos. 21–3 (1906) p. 704.

Neocuterebra, type species *N. squamosa*. This form exhibits resemblances to the purely neotropical Œstridæ-Cuterebrinæ and to the Muscidæ, but without a knowledge of the imago the systematic position is uncertain.

Some interesting cases of the occurrence of Œstrid larvæ in unusual situations and hosts are discussed. These have been observed most frequently in beasts of prey, e.g. the case of the larva of *Œstrus ovis* in the stomach of a lion.

Green Pigment of Locustids.*—P. Podiapolsky finds that the green pigment of *Locusta viridissima* can be split into a yellow and a green component, as vegetable chlorophyll can be split into xanthophyll and chlorophyllin. The spectroscopic characters are closely similar, but this does not, of course, prove chemical identity. An ammoniacal solution of cochineal shows the same two absorption-bands between D and E as an aqueous solution of oxygenated blood. The position of the green pigment along the tracheæ in the wings is interesting. Is it chlorophyll which the insect gets from its food and deposits, like a fat, peripherally? Or is it a quite different pigment which the insect manufactures for itself?

Enemies of the Olive.†—A. Berlese and his collaborateurs at the Entomological Station at Florence have made a scientific and practical study of some of the insects infesting the olive, especially the olive-fly, *Dacus oleæ*. The studies refer to many other insects, and give valuable suggestions as to counteractive measures.

Italian Scale Insects.—G. Leonardi ‡ describes a number of new forms, including *Micrococcus* and *Macrocerococcus*, as new genera of Dactylopiinæ. He also discusses§ *Aonidiella aurantii* (Mask.) a scale-insect of the orange, new to Italy. In another paper he describes *Paleococcus pulcher*, *Lecanodiaspis baculifera*, *Aulacaspis penzigi*, and other new species collected by O. Penzig‖ from the island of Giava. The illustrations in these papers are of great excellence.

New Copeognathi.¶—Costantino Ribaga describes two new Psocidæ from Tuscany—*Dorypteryx albicans* Rib. sp. n., a representative of a genus hitherto known only by an American species, *D. pallida* (also reported from Germany), and *Myopsocus eatoni* MacLachl. var. *europæus* Rib. (var. n.).

Sub-division of Genus Aphis.**—G. del Guercio proposes to subdivide the genus *Aphis* into four genera—*Anuraphis*, with *Aphis pyri* Koch as type; *Aphis* L., with *Aphis sambuci* L. as type; *Uraphis*, with *Aphis genistæ* Kalt. as type; and *Microsiphon*, with *Aphis tormentillæ* Pass. as type.

* Zool. Anzeig., xxxi. (1907) pp. 362–6 (1 fig.).
† Redia, iv. (1907) pp. 1–180 (60 figs.).
‡ Boll. Lab. Zool. Portici, 1907, pp. 135–69 (61 figs.
§ Tom. cit., pp. 117–34 (20 figs.).
‖ Ann. Scuola Agric. Portei, vii. (1907) pp. 1–22 (38 figs.).
¶ Redia, iv. (1906) pp. 181–9 (1 pl.). ** Tom. cit., pp. 190–2.

Whitefly Ravages in Florida.* — E. W. Berger states that the whitefly, *Aleyrodes citri*, a member of the Hemiptera, is on the increase and spreading to citron-growing sections of the State of Florida not hitherto infested. He advocates the application to the trees of fungi which parasitise the larvæ and pupæ. Spraying spores of the red and yellow *Achersonia* upon the trees gives very good results. An outline of the life-history of *Aleyrodes* is given.

Cimex lectularius in Relation to Spirochætes.† — A. Breinl, Allan Kinghorn, and J. L. Todd give an account of attempts made to transmit Spirochætes by means of the bed-bug, *Cimex lectularius*. The general conclusion arrived at is that it is probably unable to transmit *Spirochæta duttoni* or *S. obermeieri*, and therefore that it cannot be an important factor in the causation of epidemics of relapsing fever.

Structure of Larval Ephemerid.‡ — A. Popovici-Baznosanu communicates some notes on the structures present in the posterior part of the body of the larva of *Cloë* (*Cloëopsis*), particularly the heart, tracheal system, and alimentary canal. There is a pair of longitudinal tracheæ with commissures; each of the lateral tail filaments has a tracheal branch, the median one has two. The branches of the commissure of the ninth segment are functionally of special importance. On the one side, they serve to oxygenate the blood entering the last pair of ostia, on the other side they pass to the rectum, taking part in the respiration, which is effected in that region. There is a special ring-musculature of the rectum, effecting regular contractions in this relation. The filaments regulate movements, rather than materially assist in respiration. They are readily regenerated.

Studies on Collembola.§ — Jur. Philiptschenko has investigated various Achorutidæ, Entomobryidæ, and Sminthuridæ, with especial reference to the fatty bodies (which contain fat, eosinophil granules, and concretions of uric acid), the exuvial glands (which are unicellular and without efferent opening, and to be distinguished from the two-celled Plotnikow's exuvial glands of beetle larvæ, and the three-celled Verson's exuvial glands of higher insects). Attention is also directed to the sub-hypodermal cells of *Orchesella rufescens*, which seem to represent primitive forms of œnocytes.

Anurida maritima.‖ — A. D. Imms has devoted a memoir to this littoral Collembolan. He begins with an account of its habits. When the tide rises, it retreats far into the niches of the rocks or into the sand. The whitish hairs hold a supply of air, which may last for 4½ days. The appearance of the animals on the surface of shore-pools is accidental. They feed mainly on the dead bodies of small marine animals, but small algæ are also found in the mid-gut. The distribution is widespread in Palæarctic and Nearctic regions. A full account of the structure is given.

* Florida Agric. Exper. Stat., Bull. No. 88 (1907) pp. 51–85.
† Centralbl. Bakt. Parasitenk., xlii. (1906) pp. 537–41.
‡ Arch. Zool. Expér., Notes et Revue, No. 3, xxxv. (1906) pp. lxvi.–lxxviii. (10 figs.).
§ Zeitschr. wiss. Zool., lxxxv. (1906) pp. 270–304 (2 pls.).
‖ L.M.B.C. Memoirs, xiii. (1906) pp. 1–99 (7 pls.).

The yellow eggs are laid in fissures in the rocks, and those of individual females are not kept separate. They are spherical in form, about 0·3 mm. in diameter, and thus well suited for embryological study. An account of the development is given, mainly corroborating the results of previous observers. The memoir concludes with a useful chapter on marine insects.

γ. Myriopoda.

Spermatocytes of Lithobius.*—M. W. Blackman discusses the condition of the chromatin during the growth period and its later behaviour in the prophase. The results obtained in *Lithobius* confirm the author's earlier work in *Scolopendra*, in which he found that the chromatic threads in the growth period are aggregated into a very dense mass, the karyosphere, and at the beginning of the prophase the chromosomes arise from this mass directly.

δ. Arachnoidea.

Pseudoscorpion of Guatemala.†—E. W. Berger makes a note on the occurrence of *Atemnus elongatus* Banks, east of the highlands of Guatemala. It has previously been recorded from Florida only. Examination of the specimens showed that the female is fertilised prior to egg-laying, and that she may retain the spermatozoa for some short time (if not for a longer time) before the eggs are fertilised and laid.

Nymphon parasiticum.‡—H. Merton describes the larva of a Pycnogonid (*Nymphon parasiticum*, sp. n.) which he found as an ectoparasite on *Tethys leporina*. The eggs seem to be deposited singly under the epidermis of the Nudibranch (on the foot or about the head), for various stages from ova to well-developed larvæ were found. In all other known cases the male Pycnogonids carry the ova.

ε. Crustacea.

Decapod Spermatozoa.§—Karl Grobben discusses some of the peculiar forms of spermatozoa found in Decapods, e.g. of *Pasiphæa sivado*, *Pandalus narwal*, *Nephrops norvegicus*, *Xantho rivulosus*, *Homola spinifrons*, *Pagurus calidus*, *Pisa*, *Portunus corrugatus*, *Palinurus*, and *Scyllarus*. He shows that resemblance in the forms of spermatozoa cannot be depended on as indicating relationship of the types, though sometimes related types have similar forms of spermatozoa.

New Fresh-water Decapod from Pará.‖—W. T. Calman describes *Euryrhynchus burchelli*, sp. n., a small shrimp-like animal (Palæmonid), little more than half an inch in length, collected by Burchell from a well at Pará in 1829. He adds some notes to Miers' description of the type species *E. wrzesniowskii*.

* Proc. Amer. Acad. Arts and Sci., xlii. (1907) pp. 489–518 (2 pls.).
† Ohio Nat., vi. (1906) pp. 489–91 (1 pl.).
‡ MT. Zool. Stat. Neapel, xviii. (1906) pp. 136–41 (1 pl.).
§ Arbeit. Zool. Inst. Univ. Wien, xvi. (1906) pp. 399–406 (1 pl.).
‖ Ann. Mag. Nat. Hist., xix. (1907) pp. 295–9 (3 figs.).

Notes on a Lake Erie Shrimp.*—W. B. Herms has made some experiments on *Palæmonetes exilipes* Stimpson, the common shrimp of Sandusky Bay, Lake Erie. It is strongly and positively phototactic, not only to white light, but to red, green, violet, orange, blue, and yellow, with a probable preference for red.

Formation of Blood-corpuscles in Gammarids.†—L. Bruntz has found in *Gammarus pulex* and *Talitrus locusta* that the blood-corpuscles are formed in lymphoid organs in the front of the head extending between the eyes, and quite distinct from the "frontal organs" of Della Valle.

Female Gonads of Cypridina.‡—Alfred Ramsch fills a gap by giving a careful description of the ovary, oviduct, oogenesis, and external genital parts of *Cypridina mediterranea* Coste. The paired ovaries lie on the sides of the stomach-intestine, and belong to the saccular type. Both ovary and oviduct are laterally compressed; the germinative area (a syncytium) is confined to the side towards the median plane. From the germinative area the ova pass by bulgings of the ovarian envelope into follicles, where they grow. Thence after completion of their growth the eggs pass back into the lumen of the ovary, and very rapidly via the oviduct to the brood-chamber. The spermatozoa are disposed in egg-shaped spermatophores. There is no receptaculum seminis.

Parasitic Castration of Rhizocephala by Cryptoniscids.§—Caullery finds that *Liriopsis* has an indirect influence from a distance on the ovary of *Peltogaster*, producing temporary atrophy, and that *Danalia* parasitic on *Sacculina* has a similar effect, inducing total degeneration of the ova in process of maturation. In both cases the influence makes itself felt from a distance, somehow saturating through the body.

Annulata.

Development of Saccocirrus.‖—Umberto Pierantoni gives an account of the maturation, fertilisation, segmentation, embryonic and larval stages of *Saccocirrus papillocercus* Bobr.

The gastrulation is intermediate between the epibolic and invaginate modes. The entomeres proliferate within a precociously formed segmentation cavity, without the ectomeres multiplying; the invagination is reduced almost to nil, the archenteron and blastopore being represented by a slight indimpling.

The polar bodies are very large and penetrate into the segmentation cavity, where they divide into larval cœlomic corpuscles.

These are two of the many interesting points in this communication.

Peripheral Nervous System of Earthworm.¶—Engelbert Dechant gives a detailed account of this. The nervous elements of the earth-

* Ohio Nat., vii. (1907) pp. 73–9 (2 figs.).
† Comptes Rendus, cxliii. (1906) pp. 1256–7.
‡ Arbeit. Zool. Inst. Univ. Wien, xvi. (1906) pp. 383–98 (1 pl.).
§ C.R. Soc. Biol. Paris, lxii. (1907) pp. 113–15.
‖ MT. Zool. Stat. Neapel, xviii. (1906) pp. 46–72 (2 pls.).
¶ Arbeit. Zool. Inst. Univ. Wien, xvi. (1906) pp. 361–82 (2 pls. and 2 figs.).

worm's epithelium are (1) sensory nerve-cells, which are either arranged in "organs" or occur singly; (2) here and there unipolar nerve-cells; and (3) the diffusely distributed superficial nerve-endings which spread out on the surface of the epithelium and form much ramified anastomoses and enter into relations with the epithelial cells (directly uniting with sensory nerve-cells or ending freely at glandular cells). In the buccal cavity there are other free nerve-endings—the club-fibres.

At the basis of the epithelium there is the sub-epithelial network, consisting partly of processes of the sensory nerve-cells and partly of the nerve-fibres of the superficial nerve-endings. In the buccal cavity there are some bipolar nerve-cells in this network. The pharyngeal ganglion is a dense aggregate of ganglion cells in the network. An important point is the conclusion that the free nerve-endings do not enter into connection with the processes of the sensory nerve-cells, but are quite distinct from these and just as primary.

Antarctic Polychæts.*—Ch. Gravier makes a preliminary note on Antarctic Polychæts collected by the Charcot expedition. Thirty-six species, representing thirty-two genera, were obtained, and of these fifteen species and one genus were new. The new genus—*Helicosiphon*—is a Serpulid. Some of the species are closely related to boreal species. There is a resemblance between the Antarctic Polychæt fauna and that of the extreme south of South America.

Nematohelminthes.

Conditions of Development of Nematodes.†—L. Jammes and A. Martin have made experiments on the behaviour of the ova of *Ascaris vitulorum* Goeze in different kinds of environment. The egg is in most cases effectively preserved by the semi-permeability of the shell. The nutrition of the embryo is secured by the reserves, and sufficient water is allowed to enter. Temperature affects the rate of segmentation. The host affords a succession of media, one acid, the other alkaline, and a high and constant temperature. The embryo, protected by the shell, traverses the acid medium of the stomach. Thereafter, when the shell has become more permeable, the embryo passes into the alkaline medium of the intestine, where it finds the conditions necessary for its further development.

Worm Parasites of the Russian Polar Expedition.‡—O. von Linstow records from the collections of this expedition (1900–3), two Nematodes, *Ascaris dehiscens* sp. n., and *A. osculata* Rud.; three Acanthocephala, two of which are new; and seventeen Cestodes, most of which are new. Amongst the Cestodes are representatives of two new genera; *Skorikowia* g. n. is without vagina, but does not belong to the sub-family Acoleïnæ; it appears to belong to the *Hymenolepis* group. *Notobothrium* g. n. belongs to the Bothriocephalidæ. The type species is *N. arcticum* sp. n., from *Harelda glacialis*.

* Comptes Rendus, cxliv. (1907) pp. 43–4.
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 137–9.
‡ Mém. Acad. Imp. Sci. de St. Pétersbourg, xviii., p. 17 (3 pls.). See also Centralbl. Bakt. Parasitenk. Ref., xxxviii. (1906) p 771.

New Nematodes.*—O. v. Linstow describes *Heterakis cordata* sp. n., from the gut of *Callipepla squamata*, from Mexico; *H. paradoxa* sp. n., from the gut of *Didelphys dorsigera* L.; *Cloacina octodactyla* sp. n., from the bronchi of *Canis familiaris*; *Proleptus tortus* sp. n., from the gut of *Cistudo ornata* Ag. A note is added on the lip characters of *Ascaris obtusocaudata* Rud., and on the dimensions of its ova.

Intestinal Worms of African Pigmies.†—A. Looss had an opportunity of examining the fæces of a pigmy people in central Africa. He found the eggs of five Nematodes, viz. *Ankylostomum*, *Ascaris*, *Trichocephalus*, *Schistosomum hæmatobium*, and *Oxyuris vermicularis*. The *Ankylostomum* belonged to the species *Nacatru americanus*, which is distributed over the southern states of North America, South America, and Brazil, amongst whites and natives.

Shell of Ascaris ovum.‡—L. Jammes and A. Martin find, as a result of experiment with the eggs of *Ascaris vitulorum*, that the shell is more readily permeable by gases than by substances in solution. The semi-permeability of the shell is neither perfect for all substances, nor does this property continue indefinitely for a given substance.

Filaria of Agama colonorum.§—J. Rodhain makes a note of the presence of filaria embryos in the peripheral blood of *Agama colonorum* in the Congo Free State. Of twelve animals examined, four were found to be infected.

Case of Trichinosis with living Trichina.‖—V. Babes describes a case of trichinosis in a twenty-one year old subject in Roumania, in which the trichinæ were alive. The case is of interest, as trichinosis has been absent from Roumania for more than twenty years, and as a later infection in this instance is to be regarded as out of the question. The diseased conditions, which were numerous, and affected heart, kidneys, liver, etc., were doubtless the result of a pathological metabolism of many years, whose products acted on these organs with toxic effect.

Platyhelminthes.

New Phyllobothridæ.¶—Bruno Klaptocz describes from *Notidanus* (*Hexanchus*) *griseus* two Phyllobothridæ, viz. *Monorygma rotundum* sp. n. and *Crossobothrium campanulatum* sp. n. He gives a detailed account of the ripe proglottis of the latter and a key to Phyllobothrid genera.

Cestodes of Birds.**—W. Clerc gives an account of the Cestode parasites of the birds of Oural, dealing with the genera *Hymenolepis*, *Trichocephaloidis*, *Dilepis*, *Choanotænia*, etc. O. Fuhrmann discusses the general characters of the genus *Hymenolepis* and its distribution

* Centralbl. Bakt. Parasitenk., xli. (1906) pp. 749–52 (1 pl.).
† Lancet, 1905, ii. p. 130.
‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 15–17.
§ Centralbl. Bakt. Parasitenk., xlii. (1906) pp. 545–6.
‖ Tom. cit., pp. 541–5, 616–19.
¶ Arb. Zool. Inst. Univ. Wien, xvi. (1906) pp. 325–60 (1 pl. and 4 figs.).
** Centralbl. Bakt. Parasitenk., xlii. (1906) pp. 532–7, 620–8, 713–30, 730–55.

amongst the families of birds. It forms with the genera *Aploparaxsis* Clerc, *Diorchis* Clerc, and *Oligorchis* Fuhrmann a very natural group, which constitutes a sub-family of the Cyclophyllidæ. The diagnoses of this sub-family and the genera comprising it are given.

Helminthological Notes from Brazil.*—P. S. de Magalhães describes the cysticercus of *Tænia cuneata*. The adult is found in the intestine of fowls in Rio de Janeiro, the cysticercus occurs in large numbers in an Oligochæte of the genus *Pheritima*. The cysticerci have a double-walled capsule, the inner layer of which consists of a single stratum of large cells. They have no tail appendage, and possess a simple circlet of 12-14 hooks. In the same species of *Pheritima*, but less frequently, there occurs another tailless cysticercus, which is divided by a constriction into two parts, and which has a simple rosette of 13 needle-like hooks. Also, there occurs in *Pheritima* a small Nematode, *Synoecnema fragile*, g. et sp. n. They are found free in the body-cavity of the host, the two sexes being joined pair-wise. The eggs possess stiff cilia, are elliptical, and measure 40-280 μ.

New Species of Acanthocotyle.†—V. Willem describes *Acanthocotyle branchialis* sp. n. from the gill-chamber of a ray caught off the coast of Belgium, and points out how it differs from the three known species—*A. lobiancoi*, *A. elegans*, and *A. oligoterus*. He also reports on *Distomum turgidum* Brandes lodged in an evagination of the duodenum of the frog, with its mouth away from the gut. This form is new to Belgium.

Vital Rhythm of Convoluta.‡—Georges Bohn finds that the oscillations of *Convoluta* in an aquarium, as on the shore, become less and less marked at the time of neap-tide, and are accelerated at spring-tide, though this contrast may be affected by variations in illumination. In the aquarium, as on the shore, the emergence from the sand begins between 3 hours 40 minutes and 5 hours before the low tide, and lasts for about two hours.

Incertæ Sedis.

Pericardial Vesicle of Enteropneusta.§—C. Dawydoff has studied the development of the cardio-pericardial structures in the regenerating proboscis of *Ptychodera minuta* Kow., and comes to the conclusion that the pericardial vesicle cannot be regarded as the equivalent of a half of the proboscis cœlom; that it is primarily a paired structure; that in "atavistic" cases there are two vesicles, one arising from each half of the cœlomic cavity of the proboscis, that these vesicles are homologous with the pericardial vesicles of Molluscs and Tunicates; that it is possible that the pericardium of the Enteropneust proboscis owes its origin to a constricting off of the distal ends of procardiac tubes (in ancestral forms) penetrating into the interior of the stalk of the

* Arch. de Parasitol., ix. (1905) pp. 305–18. See also Centralbl. Bakt. Parasitenk., Ref., xxxviii. (1906) p. 772.
† Bull. Acad. R. Belgique (Classe des Sciences), No. 8 (1906) pp. 599-612 (1 pl.).
‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 51–2.
§ Zool. Anzeig., xxxi. (1907) pp. 352–62 (7 figs.).

proboscis; that it may be that the pericardium is a metameric structure, and that the perihæmal (cœlomic) canals of the collar represent the pericardium of the second segment.

Rotifera.

Intestinal Absorption and Formation of Reserve Material in Rotifera.*—P. de Beauchamp, having studied these subjects in *Hydatina senta*, comes to the conclusion that, in addition to fat globules, there are formed, when food is abundant, proteid granules which are stored in the cells of the stomach, and also glycogen stored in the hypodermic cells of the rotatory organ, in the muscle-cells, and in the maturing ova. All these reserve materials are absorbed again during fasting.

Rotifera of the Scottish Lochs.†—James Murray gives an account of 177 species collected by him during the work of the Scotch lake survey in a large number of lochs. The author points out that this list is by no means an exhaustive one, as no doubt many more species could have been added if all the lakes had been searched more thoroughly by a few specialists. The principal forms occurring in the various regions of the lakes—pelagic, littoral, and abyssal regions—are examined and compared with the forms occurring in similar situations in other countries. Finally, notes on some of the species and descriptions of six new species are added, namely: *Philodina hamata; Callidina longiceps; Callidina habita* var. *bullata; Callidina natans*, by the author; *Philodina flaviceps*, by James Bryce; and *Notommata pumila*, by C. F. Rousselet. Six plates accompany this memoir.

South American Rotifers.‡—James Murray enumerates 13 species of Bdelloid Rotifers obtained from dried moss collected in British Guiana, amongst which are two new species: *Callidina tripus* and *Callidina speciosa*, and two new varieties: *Callidina perforata* var. *americana* and *Callidina multispinosa* var. *crassispinosa*, all of which are figured and described.

Echinoderma.

Spicule-formation in Echinoderms.§—W. Woodland has studied *Amphiura elegans, Ophiothrix fragilis, Echinus esculentus, Synapta hispida* and *S. digitata*, and *Antedon bifida*, with reference to the formation of spicules.

In Ophiuroidea, Asteroidea, Echinoidea, and Crinoidea the typical mode of scleroblastic development of the spicules is that which the author describes in detail for *Amphiura elegans*, i.e. the spicule originates as a triradiate structure contained within a single cell. The typical mode of development of the plates of Holothuroidea is that described by the author for Cucumariidæ, viz. the origin of the elongated calcareous needle between two or four cells, its growth to form

* Comptes Rendus, cxliv. (1907) pp. 524–5.
† Trans. Roy. Soc. Edinburgh, xlv. part 1, No. 7 (1906) pp. 151–91 (6 pls.).
‡ Amer. Nat., xli. (1907) pp. 97–101.
§ Quart. Journ. Micr. Sci., li. (1907) pp. 31–43 (2 pls.).

a rod, the bifurcation of the extremities of this rod, and so on. In the case of *Chiridota venusta*, however, Semon has described the triradiate origin of certain spicules.

The quantity of lime respectively secreted by most Echinoderms and by Holothurians differs greatly—in the former group the stroma is packed with a calcareous stereom, whereas in most individuals of the latter the skeleton is only represented by isolated spicules; and correlated with this difference is (*a*) the fact that in the former group every scleroblast gives rise to a spicule, whereas in the latter at least two scleroblasts have to co-operate for the same purpose; and (*b*) the equally cogent fact that in most Echinoderms the scleroblasts multiply very rapidly (shown by the number of scleroblasts per spicule), whereas in Holothurians they multiply very slowly.

Meristic Variation in Common Sun-star.*—D. C. McIntosh has examined 612 specimens of *Solaster papposus*. He gives the following variation table:—

									Total.
No. of arms .	9	10	11	12	13	14	15	16	612
No. of specimens	1	8	19	154	351	72	6	1	
Percentage .	0·16	1·3	3·1	25·1	57·4	11·8	0·98	0·16	100

It appears, therefore, that 12-, 13-, and 14-rayed forms account for 94 p.c. of the total. The curve of frequency is a simple uni-modal one (Pearson's Type IV.).

Hawaiian Echinoids.†—A. Agassiz and H. L. Clark make a preliminary report on 2450 specimens of Echinoids collected by the 'Albatross' in 1902 among the Hawaiian islands. There are 49 genera represented, 5 of which are new, and 67 species, of which 36 are new.

Cœlentera.

Responses of Actinia.‡—G. Bohn has investigated these with particular reference to the effect of agitation of the water. In the various species of *Actinia* this stimulus produces what he terms a kind of "physiological misery," manifested by a marked tendency to retract the tentacles which may disappear completely under an annular fold of the body wall. Such a phenemenon is the most habitual response to the different excitations which might harm the life of the individual. The author, however, recognises differences in the character of the response traceable to the time of the tides, hour of the day, purity of the water, nature and solidity of the support, and so on. In short, when all the factors are considered, the reactions of these and other shore animals seem to be not vague but definite.

Formation of the Skeleton in Hexacoralla. — Armand Krempf discusses the cytological phenomena concerned in the skeleton-making in *Seriatopara*. According to Heider (1881), the skeleton is due to the juxtaposition of minute elements or calicoblasts, which are practically

* Proc. Roy. Phys. Soc. Edinburgh, xvii. (1907) pp. 75–8 (1 curve).
† Bull. Mus. Comp. Zool. Harvard, l. (1907) pp. 231–59.
‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 395–8.
§ Comptes Rendus, cxliv. (1907) pp. 157–9.

cells that have undergone complete calcification. According to Koch (1882), the skeleton is formed by extracellular secretion. According to Krempf, each cellular area of the calicoblast layer functions like a gland with merocrinal secretion, and the secreted material is elaborated entirely within the cell.

Developmental Stages in Rugose Corals.*—Thomas C. Brown inquires whether there are only four primary septa in rugose corals, as suggested by Kunth and until recently accepted by the majority of workers, and recently shown by Gordon for *Streptelasma profundum*, or whether there are six primary septa, as suggested by Ludwig and the Count de Pourtales, and claimed as definitely proved by Duerden.

Brown has studied developmental stages in *Streptelasma rectum* Hall, and he finds that in this species there is primary tetramerism. It is probable that all the rugose corals are primarily tetrameral, and that the appearance of six septa in the early stages of geologically late species is due to the early development of the first pair of secondary septa.

Primnoa reseda and its Embryos.†—J. Arthur Thomson describes a fine specimen of *Primnoa reseda*, the only species of its genus, from the Faeroe Channel, 355 metres. It was almost a yard in height (34 inches), and its branches spread out for 16 inches. The colour of the fresh colony, which soon faded, was a brilliant salmon-pink. In alluding to this fact as new—for previous descriptions seemed to agree in describing the animal as white—the author overlooked the reference to this species in Hickson's contribution to the Cambridge Natural History (vol. i., p. 338), where the colour is described as "diffuse salmon-pink."

Many of the colonies were crowded with diploblastic embryos, spherical or ovoid in shape, from 0·4–0·8 mm. in diameter or along the longer axis. The ectoderm consisted of a single layer; the endoderm was a dense mass of cells. There was a large cœlenteron and a very marked middle lamella.

New Genus of Pennatulids.‡—Ch. Gravier describes *Mesobelemnon gracile* g. et sp. n. in the family Kophobelemnonidæ. It differs from *Kophobelemnon* and *Sclerobelemnon* in the form of the spicules, in the very short pinnules of the tentacles, and in the much smaller number of siphonozooids, which are, however, individually well developed. The spicules of the stalk are smooth two-headed rods, rounded at each end, and sometimes drumstick like. The locality was the Gulf of Tadjourah, on the coast of Somaliland.

Pulsations in Jelly-fish.§—A. G. Mayer has made some important experiments. When the marginal sense-organs of the jelly-fish (*Cassiopea*) are cut off, the disk is paralysed and does not pulsate in sea-water. But if a ring-like cut, or a series of concentric broken ring-like cuts be made through the muscular tissue of the sub-umbrella, the mutilated disk responds to mechanical, electrical, or chemical stimulus, and

* Amer. Journ. Sci., xxiii. (1907) pp. 277–84 (13 figs.).
† Proc. Roy. Phys. Soc. Edinburgh, xvii. (1907) pp. 65–72 (2 pls.).
‡ Comptes Rendus, cxliv. (1907) pp. 439–40.
§ Carnegie Institution of Washington Publications, No. 47 (1906) pp. 1–62 (36 figs.).

suddenly springs into rapid rhythmical pulsation, regular and sustained like clockwork, and continuing indefinitely in normal sea-water without further external stimulation. The waves of pulsation all arise from the stimulated point, and the labyrinth of sub-umbrella tissue around the centre must form a closed circuit. When each wave returns to the centre it is reinforced and again sent out through the circuit. The centre sustains the pulsation, and once established it remains at a fixed point, while the disk continues to pulsate. Sustained pulsation in disks (without marginal sense-organs) occurs only in tissue forming a complete circuit, and depends upon an electric transmission of energy. The pulsation is fully twice as fast as that of a normal Medusa, its rate depending on the length of the circuit, and it is self-sustaining (i.e. sustained by internal stimuli) once it is started by an external momentary stimulus. The stimulus which causes pulsation is transmitted by the diffuse nervous or epithelial elements of the sub-umbrella.

The paralysed disk is stimulated by chlorides of Na, K, Ca, etc., especially by the sodium chloride of the sea-water, but magnesium salts control and inhibit this stimulation. The same is true in regard to the heart of *Salpa*, the heart of the embryo loggerhead turtle, and the barnacle's cirri. The NaCl, K, and Ca of the sea-water unite in stimulating pulsation of the *Cassiopea* disk and in resisting the stupefying effect of the Mg. All four salts conjointly produce, in sea-water, an indifferent, or balanced, fluid, which neither stimulates nor stupefies the disk of *Cassiopea*, and permits a recurring internal stimulus to produce rhythmic movement.

The chief results of Mayer's research are the discovery of a new method of restoring pulsation in paralysed Medusæ, and also that magnesium plays a most important role in restraining, controlling, and prolonging pulsation in animal organisms. In *Cassiopea* the ectodermal, epithelial, or diffuse nervous elements of the sub-umbrella transmit the stimulus which produces rhythmical contraction.

Rhythmical pulsation can be maintained only when a stimulus and an inhibitor counteract one another, and cause the organism to be upon the threshold of stimulation, thus permitting weak internal stimuli to promote periodic contractions.

Supposed Australasian Hydroid in North Sea.*—James Ritchie reports the occurrence in the North Sea of *Sertularia elongata* Lamx, which is limited to Australasian waters. It was attached to a twig, apparently belonging to one of the Cymodoceæ (Potamogetonaceæ), which, with one exception (the north temperate *Phucagrostis major*), occur in tropical or south temperate seas. As the twig was not *Phucagrostis major* it seems likely that it has drifted with the attached hydroid to the North Sea probably from an Australian locality. The specimen, which was a fine one, was found on the net of a trawler.

Intranuclear Crystals in Tubularia.†—Jovan Hadži finds that the nuclei of the ectoderm cells of the aboral tentacles of *Tubularia mesembryanthemum* often show a peculiar crystalloid plate of hexagonal form. It is probably a symptom of some degenerative change.

* Proc. Roy. Phys. Soc. Edinburgh, xvii. (1907) pp. 78–81 (1 pl.).
† Zool. Anzeig., xxxi. (1907) pp. 375–9 (7 figs.).

Protozoa.

Fine Structure of Test of Arcella.*—J. A. Cushman and W. P. Henderson find that the test of *Arcella vulgaris* is far from the simple hexagonal structure figured by Leidy and other authors. The hexagons have no sides in common; three adjacent sides of three neighbouring areas inclose a small triangular space. These interpolated triangles are not solid portions of the network, but themselves contain areoles of sub-triangular outline. These are depressed areas in the network similar, except in point of size and shape, to the hexagonal areas. Diagrammatically the network may be conceived as formed of straight lines in three sets of parallels, the lines of each set making an angle of sixty degrees with those of the two other sets. Moreover, new columns of hexagonal areas are during growth added or interpolated among the previous ones. These new columns may be added in any of the three directions conforming to the directions of the three sets of parallel lines already referred to.

Cultivation and Pathogenesis of Amœbæ.†—W. E. Musgrave and M. T. Clegg, publish an important paper on this subject. The most interesting question dealt with is the property possessed by apparently saprophytic amœbæ from the outside world, by virtue of which they become so modified by successive stages and changes in their environment or by symbioses that they become true parasites for monkeys, guinea-pigs, and human beings. Numerous facts in the biology of amœbæ are communicated, and it has been found difficult to systematise the points in such a way as to justify classification of species. Such work is regarded as at present premature. The authors, therefore, question the conclusions of Schaudinn and others regarding the existence of a non-pathogenic *Entamœba coli* and a pathogenic *E. histolytica*. In cultures, single species are often found which possess a combination of some of the features which have been described as distinctive for different species.

Variability of Commensal Forms of Opercularia.‡—E. Fauré-Fremiet calls attention to the variability of these Vorticellids which occur as commensals on *Notonecta*, *Corixa*, *Dytiscus*, and other aquatic insects. Being thus removed from the stringency of natural selection, they show greater variability—like domesticated animals—than related non-commensal forms.

Studies on Peridineæ.§—V. Dogiel has studied a number of Mediterranean forms with especial reference to their reproduction, e.g. *Gymnodinium lunula*, *G. spirale*, var. *obtusum*, and five new species, *G. roseum*, *G. affine*, *G. parasiticum* (in the eggs of a Copepod) *G. cœruleum*, and *Pouchetia armata*.

New Species of Giardia.‖—J. Kunstler and Ch. Gineste describe *Giardia alata* sp. n. from the intestine of tadpoles taken near Paris. It

* Amer. Nat., xl. (1906) pp. 797–802 (5 figs.).
† Philippine Journ. Sci., i. No. 9 (1906) pp. 909–50 (5 pls.).
‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 153–5.
§ MT. Zool. Stat. Neapel, xviii. (1906) pp. 1–45 (2 pls.).
‖ Comptes Rendus, cxliv. (1907) pp. 441–3 (1 fig.).

is a remarkable form with eight flagella, and with a sharp distinction between an anterior "head" region (with a sort of cupuliform sucker) and a flattened vibratile "tail" region. It seems to be different from *G. agilis*. Both are related to *Lamblia intestinalis*.

Morphology of Trypanosomes.*—H. G. Plimmer points out that it is impossible at present to insist that any differentiation based solely upon microscopical observations should be sufficient in the case of organisms so much alike as the Trypanosomata. Our methods and observations are neither uniform nor good enough to enable us to make, at the present time, by the microscopical method alone, a sufficient differentiation. Until all observers use the finer zoological methods of fixation, etc. (the author suggests a method) instead of the barbarous one of drying blood films at present almost exclusively in use, we cannot look for much certainty in the microscopical differentiation of very similar organisms. This must be supplemented by observing the differences in their pathogenic action. Nor must we forget the variability of organisms in the same species of animals in the same country, and their still greater variability in different animals in the same and in other countries.

Effects on Rats of Trypanosomata of Gambia Fever and of Sleeping Sickness.†—H. G. Plimmer records the results of 211 experiments. These go to show that each of the two strains of Trypanosomata has produced two different effects in the same class of animals under conditions of which we at present know nothing; and that the Trypanosomata found in these two types of disease are one and the same organism, modified by passage from man through monkeys to rats, and perhaps in the author's strains by transplantation into animals of, and in, another country. The view that Gambia fever and sleeping sickness are two distinct diseases cannot longer be maintained.

Notes on Trypanosomata.—A. Bettencourt and C. Franca ‡ describe a new Trypanosome, *T. pestanai*, from the badger. The same observers§ record the occurrence of *T. cuniculi* Blanchard in Portugal. They review ‖ the literature and clear up the synonymy of the Trypanosome of bats, *T. vespertilionis* Battaglia, 1904, and describe its appearance, both living and in preparations. C. Franca and M. Athias ¶ give an historical account of the Trypanosome parasites of *Rana esculenta*, proposing for the two first known forms the nomenclature *Trypanosoma loricatum* or *costatum* Mayer, and *Trypanosoma rotatorium* Mayer. These are redescribed, as also *T. inopinatum* Ed. et Et. Sargent; *T. undulans* sp. n; *T. elegans* sp. n.

A. de Magalhães ** gives an account of the treatment of rats infected with *T. gambiense* by means of arsenic acid and trypan-red.

Malaria Parasites in Attica and Bœotia.††—J. Cardamatis and L. Diamesis give an account of a malaria epidemic in these regions in

* Proc. Roy. Soc., Series B, lxxix. No. B 529 (1907) pp. 99 and 102.
† Tom. cit., pp. 95-102.
‡ Arch. Inst. Roy. de Bacteriologie, Camara Pestana, i. (1906) pp. 73-6 (1 pl.)
§ Tom. cit., pp. 167-70.
‖ Tom. cit., pp. 187-94.
¶ Tom. cit., pp. 127-66 (2 pls.).
** Tom. cit., 171-6.
†† Centralbl. Bakt. Parasitenk., xlii. (1906) pp. 527-32 (1 pl.).

the summer of 1905. The mosquitos involved were, first *Anopheles superpictus*, next *A. claviger*, and, rarest of all, *A. bifurcatus*. Of 300 cases, 148 were infections of *Præcox*, 87 of *Vivax*, 3 of *Pl. malariæ*, 14 of *Vivax-Præcox*, 2 of *Pl. malariæ-Præcox*, while 46 were undetermined. The observers give some notes on the ring form of parasites, and discuss the significance of free chromatin-granules and pigment-corpuscles which occur in malaria blood. These are regarded as the remains of dead parasites, and are important for diagnosis in cases where the parasites are absent.

Spirillosis of Fowl.*—Levaditi and Manouélian find that Brazilian septicæmia is not due to an exclusively vascular proliferation of *Spirillum gallinarum*; the parasite invades the different glandular tissues and comes into intimate contact with cellular elements. *Treponema pallidum* does not appear to penetrate into the protoplasm of the cells. The crisis which ends the infection is due to phagocytosis of the spirilla, by the macrophages of the spleen and liver. The spirillum of Marchoux and Salimbeni is capable of experimental infection of the ovary.

Bacilliform Piroplasma of Deer.†—A. Bettencourt, C. Franca, and I. Borges describe from deer in the Park at Mafra a bacilliform piroplasma exhibiting characteristic cruciform parasites as well as rod forms. It is distinct from *P. bigeminum*, and the authors propose for it the name *Theileria cervus* sp. n. Its introduction to Europe is supposed to have been brought about by infection from ticks off zebus which are in the Park at Mafra.

Sporozoon Parasite of Pearl-oyster.‡—R. Dubois found in the nucleus of a small pearl a small sac containing encysted spores of a sporozoon. The small cyst had lodged in the thickness of the mantle; it is regarded as the cause of the formation of the pearl.

New Species of Myxobolus.§—M. Auerbach describes from *Abramis brama* what seems to be a new species of *Myxobolus*, exceeding all the known forms in size, and therefore named *M. gigas*.

Intracystic Dehiscence of Spores in Myxosporidia.‖—Casimir Cépède discusses the dehiscence of the spores of *Myxobolus cycloides* from the kidney of *Leuciscus rutilus*, and shows that it is intracystic. The same is true of *Henneguya psorospermica periintestinalis*.

Ætiology of Souma.¶—G. Bouffard discusses this disease of Bovidæ and Equidæ in the Soudan, which is due to *Trypanosoma cazalboui*, and seems to be disseminated by *Stomoxys*.

Sporozoon Parasite in Blood of Yellow Fever.**—Max Schüller describes in a blood preparation of a case of yellow fever from New

* Ann. Inst. Pasteur, xx. (1906) pp. 593–600 (1 pl.).
† Arch. Real Inst. Bacteriol. Camara Pestana, i. (1907) fasc. 2, pp. 341–50. (2 pls.). ‡ C.R. Soc. Biol. Paris, xlii. (1907) pp. 310–11.
§ Zool. Anzeig., xxxi. (1907) pp. 386–91 (5 figs.).
‖ C.R. Soc. Biol. Paris, lxii. (1907) pp. 135–7.
¶ Tom. cit., pp. 71–3.
** Berl. Klin. Wochenschr., 1906, No. 7 (1 fig.). See also Centralbl. Bakt. Parasitenk., Ref., xxxviii. (1906) pp. 765–6.

Orleans an intracorpuscular parasite, piriform or oval, 0·75 μ long by 0·3–0·5 μ broad. Rosettes and sporulating forms were also observed. The parasite is apparently a sporozoon, whose merozoites penetrate the blood-corpuscles, in some cases destroying and dissolving them directly; in others only after further phases of development have occurred does this destruction take place. Especially important is the extraordinarily marked destruction of the blood-corpuscles; this in itself alone explains a part of the most important phenomena of yellow fever.

New Protozoon Genus in Daphnia.*—E. Chatton describes from the gut of *Daphnia magna* and *D. pulex* an amœboid parasite, *Pansporella perplexa*, g. et sp. n., whose systematic position, on account of reproductive peculiarities, is at present undetermined. It may be seen in living transparent examples in the anterior part of the midgut between the digestive epithelium and the peritrophic membrane.

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 42–3.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Metachromatic Corpuscles of Germination.* — J. Beauverie has investigated the pumpkin and *Ricinus* with reference to the evolution of the globoids of aleurone grains, which he classifies as metachromatic corpuscles. As the aleurone-grains disintegrate, the globoid gives rise to red granules, which are scattered uniformly throughout the cell. Later on, when the aleurone-grains have lost their individuality, these granules fuse and finally disappear. The author regards them as similar to the metachromatic corpuscles found in Cryptogams, since they have similar physiological, physical, and chemical properties. There is no evidence at present as to their function, although it is suggested that it must be either that of reserve, or of a pro-enzyme.

Cutinised Membranes of Aquatics.†—L. Géneau de Lamarlière has investigated the nature of the epidermis of aquatic plants, and finds that towards the exterior, the chemical nature is that of pectic compounds; in passing towards the interior, the pectic compounds gradually give place to cellulose. In the purely pectic membranes, secondary substances are found—e.g. cutin, aldehydes, azotes, phosphates, siliçates, and more rarely lignin. In the cutinised regions there is a thin, peripheral layer, the epicuticle, beneath which a thin cuticle develops. Generally there is also an epicuticle in the vicinity of the internal air-spaces, which is equivalent, both morphologically and chemically, to the external epicuticle. Lastly, irregular cutinisation occurs in certain plants, and the cutinized membranes have the same constitution as those of the epidermis.

Structure and Development.

Vegetative.

American Fossil Cycads.‡—G. R. Wieland has published a monograph on "American Fossil Cycads." After dealing with the internal structure and giving new information concerning the anatomy of the vegetative organs, the author describes the reproductive organs. He shows conclusively that previous views as to the unisexual character of the *Bennettites* flowers are incorrect. Numerous specimens have been

* Comptes Rendus, cxliii. (1906) pp. 924-7.
† Rev. Gén. Bot., xviii. (1906) pp. 289-95.
‡ American Fossil Cycads, 1906, viii. and 284 pp., with plates, Carnegie Institute of Washington. See also Nature, lxxv. (1907) pp. 329-30 (2 figs.).

found, consisting of an axis terminating in a conical receptacle, bearing the two sets of organs, characteristic of what was formerly regarded as the female flowers, but which appear to be partially aborted or immature. Surrounding the central receptacle is a whorl of several pinnate leaves, with their upper parts folded in between the petioles of the central gynœcium, and bearing rows of synangia similar to those of the Marattiaceæ. No specimens have yet been seen in which both the andrœcium and gynœcium are mature. This may be explained by regarding it as a case of dichogamy, in which the male organs ripen first, or as comparable to the male flowers of *Welwitschia*, in which the female portion is functionless.

Fertilisation and Embryogeny in Cephalotaxus Fortunei.*—W. C. Coker has investigated the fertilisation and embryogeny in *Cephalotaxus Fortunei*, and finds that, as in other Conifers, the pollen-tube contains two nuclei and a body-cell; just before fertilisation the latter divides into two sperm-cells of unequal size, the larger of which alone is functional. This agrees with all the Taxaceæ except *Torreya californica*, and it would seem that in all Gymnosperms whose pollen-tubes fertilise only one archegonium, there is but one functional sperm-nucleus. There are 3–5 archegonia, which are usually long and pointed below, each with a poorly-developed jacket and 2–5 neck-cells. The ventral canal nucleus has no protoplasm and gradually disappears. Both sperm-cells are discharged into the egg, the larger nucleus sinks into the egg-nucleus, and its protoplasm surrounds the fusing nuclei. Cell-walls are first formed in the 16-cell stage, thus agreeing with *Taxus* and *Podocarpus*, which are the only known Conifers in which this phenomenon occurs. The pro-embryo terminates in two long cells, which appear to have a secretive function; it much resembles that of *Taxus*.

Development of Pollen in Nymphæa and Nuphar.†—W. Lubimenko and A. Maige have studied the variations of volume of the nucleus, of the chromatic mass, and of the cell, in the course of development of the pollen of *Nymphæa alba* and *Nuphar luteum*. In the nucleus itself the relative masses of the chromatic mass have been calculated by comparing the mean surfaces of the equatorial plates of the three vegetative and pollen-forming divisions. The chief results at present obtained are, that in the vegetative parenchyma of the anther, the ratio between the volume of the nucleus and that of the cell $\left(\frac{N}{C}\right)$ is continually decreasing; on the other hand, at no stage of development of the pollen is there any absolute quantitative reduction of the chromatic mass of the nucleus.

Pollen-tube of Houstonia cœrulea.‡—C. A. Mathewson gives an account of his investigations, and shows that the cells with which the pollen-tube comes in contact have only a passive influence upon it, while

* Bot. Gaz., xliii. (1907) pp. 1-10 (1 pl., 5 figs in text).
† Comptes Rendus, cxliv. (1237) pp. 214–17 (1 fig.).
‡ Bull. Torrey Bot. Club, xxxiii. (1906) pp. 487–93 (figs. 1–3).

they themselves are but slightly affected. The behaviour of the tube seems to indicate that a chemotactic influence, arising either in the egg-apparatus or in the egg itself, determines the course of the tube, and also favours the view that the intercellular mode of growth is a physiological phenomenon and not an inherited character.

"Filiform-apparatus" of the Angiosperms.*—A. Habermann has examined *Gladiolus*, *Yucca*, *Funkia*, *Ranunculus*, *Aconitum*, *Thalictrum*, etc., with special reference to the so-called filiform-apparatus. He finds that the synergidæ possess a filiform-apparatus, which, although varying in size and distinctness, is always of similar character. *Thalictrum purpurascens* can reproduce by apogamy, and here the filiform-apparatus is much swollen. Before fertilisation, the upper parts of the synergidæ usually have a dome-like appearance; later on, the membrane of the embryo-sac in this region is absorbed, and the filiform-apparatus protrudes. After fertilisation, both synergidæ and filiform apparatus perish, but remain as a shapeless mass in the micropylar region. Simultaneously with the development of the filiform-apparatus, vacuoles appear in the lower parts of the synergidæ, and it is highly probable that these vacuoles secrete a chemotactic substance, which issues through the filiform-apparatus.

Embryo-sac of Phaseolus vulgaris.†—C. de Bruyne has investigated the embryo-sac of *Phaseolus vulgaris*, and is led to the conclusion that those authors who regard the albumen as nothing but nuclei scattered in a parietal plasmodium, are only correct in regard to the very young embryo-sac. From the time when the embryo becomes globular in form, cell-formation in the neighbourhood of the embryo can be clearly seen. These cells are uninucleate and usually spherical. There are two cavities in the embryo-sac—an upper embryonic cavity enclosing the embryo, and a lower nutritive cavity. Both cavities are bounded by membranes derived from the albumen, that of the embryonic cavity being formed of flat, thickened cells. The albumen-cells of the nutritive cavity travel towards the dividing membranes, and gradually become liquefied; and the author believes that the thickened membrane of the embryonic cavity acts as an osmotic medium for conducting the albumen to the embryo.

Embryology of "Shepherd's-purse."‡—J. H. Schaffner has published an unfinished paper dealing with investigations upon the embryology of "Shepherd's-purse." The entire embryo is developed from the two outer terminal cells of the pro-embryo. The terminal cell gives rise to the cotyledons, stem-tip and hypocotyl, while the basal cell, after cutting off one suspensor-cell, gives rise to the calyptrogen, root-tip, and calyptra. The development of the calyptrogen shows that it arises both from the terminal and basal embryo-cells. The embryo is at first straight, but later on is forced round by the curved wall of the ovule. The plerome consists of several small, elongated cells, surrounded by a sheath of larger cells, and the periblem

* Beih. Bot. Centralbl., xx. (1906) pp. 300–17 (1 pl.).
† Bull. Acad. roy. de Belgique (Classe des Sciences), 1906, pp. 577–98 (2 pls.).
‡ Ohio Nat., vii. (1906) pp. 1–7 (3 pls.).

has two layers, with an inner limiting layer. The sheath of the plerome and the inner layer of the periblem have a common origin.

Physiology.

Nutrition and Growth.

Respiration of the Flower.*—A. Maige has investigated a large number of species, including *Cucumis sativus*, *Hibiscus rosa-sinensis*, *Veronica spicata*, etc., with the view of ascertaining how the intensity of respiration of the flower varies. The author finds that respiratory intensity regularly decreases as the flower approaches maturity, but that the rapidity of decrease is very variable in different species. A few species, however, maintain a constant respiratory intensity, while others are exceptional, in that respiration is greatest when the flower is about to fade. These conclusions hold good, whether respiration is determined by the amount of CO_2 given off, or by an estimation of the weight of the flower. In most of the species examined, the dry weight gradually decreases as the flower reaches its full development, but here, again, there are exceptions corresponding with those previously mentioned.

Irritability.

Action of Electricity upon Germination.†—P. Lesarge has investigated the indirect effects of electricity upon the spores of *Penicillium* and various seeds. In the former case germination was hindered, but subsequent investigations seem to show that a similar effect is produced by growing the spores in an atmosphere impregnated with ozone and nitrogen peroxide; since these substances are always present in the atmosphere in the neighbourhood of an electric current, the hindrance of germination is probably an indirect result of electrical influence. In the case of various seeds which germinated while under the influence of an electric current, the results appear to depend chiefly upon three factors—(1) the length of time that the seeds were soaked in water, (2) the action of heat induced by the current, (3) the influence of the products of electrical action upon the air.

Metallotropism of Phycomyces nitens.‡—A. Henckel and A. Tschernjajew cultivated plants of *Phycomyces nitens* with copper, iron, and aluminium in close proximity. They found that iron attracted the plants; aluminium attracted them to a less extent; copper had a repellent influence. They also tested the infiuence of these metals within glass tubes, and found that the glass did not interfere with the effect.

General.

New Genus of Conifers from Formosa.§—Bunzo Hayata describes a new Conifer, *Taiwania*, found at 2000 metres elevation on Mt. Morrison,

* Rev. Gén. de Bot., xix. (1907) pp. 8-28.

† Comptes Rendus, cxliii. (1906) pp. 695-7.

‡ Scripta Bot. Hort. Univ. Petropolitanæ, fasc. xxiii. (1905-6) pp. 115-21 Russian, pp. 122-3 German (6 figs.) See also Bot. Centralbl., civ. (1907) pp. 210-11.

§ Journ. Linn. Soc. (Bot.), xxxvii. (1906) pp. 330-1 (1 pl.).

Formosa. The plant is somewhat anomalous, having the habit of the Japanese genus *Cryptomeria*, while the cone bears some resemblance to that of the Chinese genus *Cunninghamia*, and recalls superficially that of *Tsuga*. The vegetative shoots show the heterophylly so frequent in genera of the tribe Cupressineæ. The author considers that the genus is most nearly allied to *Cunninghamia*, from which it differs in the absence of a secondary cone-scale, and in having two ovules on each scale.

Botanical Study of Areas in the United States of North America. C. V. Piper * gives an account of the flora of the State of Washington, so far as concerns the vascular plants. The systematic portion is preceded by a brief historical account of botanical exploration in the State, a description of its physiography, geology, and climate, and a discussion on the zonal distribution of the plants, with a reference to regions of peculiar botanical interest. This part is illustrated by numerous excellent plates depicting scenery and plant associations. In the systematic account each genus is provided with a key to the species. A list is given of nearly 190 species and sub-species, including two monotypic genera, known to occur only in Washington.

R. M. Harper † has studied on similar lines the Altamaha grit region of Georgia.

Cotton-plant.‡ — A. Flatters gives an account of the microscopic structure of the cotton-plant in the form of a description of a number of photographic reproductions of microscopic preparations. These include the structure of the root, stem, leaf, flower (longitudinal and transverse sections of buds), fruit, and seed; and detailed structure of the fibre of various kinds of cotton.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Variability in Ferns.§—W. Krieger gives an account of various new and interesting forms of German Pteridophytes, collected chiefly in Saxony. In Saxon Switzerland slight variations of environment are found by the author to cause all kinds of different variations in certain species; and indeed at one spot it was quite impossible to account for the extraordinary variations exhibited by *Athyrium Filix-femina*. Thirty-four species are noted; and under *A. Filix-femina* as many as 27 varieties are enumerated without monstrosities, and even then the tale is not complete. *Polypodium vulgare* is credited with 21 varieties, and *Blechnum spicant* with 17.

Effect of Environment on Fern-structure.‖—J. H. McIlroy publishes the results of some experiments made to ascertain how far in

* Contributions from the U.S. National Herbarium, xi. (1906) 637 pp., 18 pls.
† Ann. New York Acad. Sci., xvii. part 1 (1906) 357 pp., 28 pls.
‡ The Cotton-plant: its Development and Structure, and the Evolution and Structure of the Cotton Fibre. London: Sherratt and Hughes (1906) 92 pp., 34 figs.
§ Hedwigia, xlvi. (1907) pp. 246-61.
‖ Proc. Roy. Phil. Soc. Glasgow, xxxvii. (1906) pp. 136-41 (1 pl. and figs.).

Ferns the structure of the leaf is liable to be modified in the direction of the filmy character by conditions of moisture and shade. The plants employed were *Nephrodium Filix-mas* and *Scolopendrium vulgare.* The results are described, and are shown in figures drawn with the camera-lucida and placed side by side. They are less striking than had been expected; but better results were obtained by L. A. Boodle with *Pteris aquilina*, and were published in vol. xxxv. of the Journal of the Linnean Society.

Morphology and Biology of Nephrolepis.—K. Goebel* gives the results of his cultivation of *Nephrolepis Duffii*, and concludes that it is a mutation of *N. cordifolia*, as is shown by the reversion of its pinnæ towards the shape characteristic of the latter species; that neither this nor any other fern-mutation can be regarded as the result of adaptation to external conditions. He thinks that *N. cordifolia* may be a collective species.

E. Heinricher † has studied the tubers of *Nephrolepis* in Java, which are situated on side-branches of the stolon of epiphytic plants, and serve as water-reservoirs. He describes the circumstances under which they may also act as organs of regeneration in *N. cordifolia* subsp. *tuberosa*, *N. hirsutula*, *N. plumula* var. *philippinensis*. They do not appear to diminish the spore-production of the frond. They seem to him to be of value for distinguishing species systematically. In sprouting the tuber normally forms a stolon, but in certain circumstances it may produce a rhizome. The stolons of *Nephrolepis* exhibit much plasticity, and can develop into organs for food-storage, or into tubers; and the same axis can by artificial treatment be converted from a rhizome to a stolon with distant leaves, and back again to a rhizome.

Germination of Spores of Ferns and Mosses.‡—A. Laage publishes the results of his researches upon the conditions affecting the germination of the spores of ferns and mosses. After a short résumé of the work done by previous authors, he describes his own experiments, which show *inter alia* that the capacity of a spore to germinate in darkness depends entirely upon the age and the species. *Osmunda regalis* differs from the rest of the score of species examined in its manner of germination in the dark. Its spores, when fresh, will germinate in distilled water at ordinary temperatures, and form starch, in the dark; but germination ceases after the splitting of the exine. The spores lose the power of germinating in the dark after two months, and in the light after four months. As to the spores of the Polypodiaceæ, their power of germination in the dark varies greatly according to the species. This power, very marked in *Pteris aquilina* and *Scolopendrium officinarum*, is, on the other hand, quite absent in *Asplenium lucidum*, *Alsophila australis*, and *Polypodium aureum*; none of the species experimented with form starch. The author treats of the relation between the formation of rhizoids and of the germination-tube, and describes the constitution of the nutrient fluids employed. As

* Flora, xcvii. (1907) pp. 38–42 (figs.).
† Tom. cit., pp. 43–75 (2 pls. and figs.).
‡ Beih. Bot. Centralbl., xxi. Abt. 1 (1907) pp. 76–115 (figs.).

to the mosses, the spores of *Funaria hygrometrica* and *Bryum cæspiticium* germinate in the dark in attenuated solutions of salts, which exercise a slight osmotic force. The spores of *Polytrichum commune* are incapable of germination in the dark in any of the solutions experimented with—namely, very weak solutions of inorganic salts or solutions of organic iron salts. Numerous tables of experiments are given, which show the reaction of the various spores to the various strengths of the salt-solutions employed in light and in darkness.

Fern Hybrids in Russia.*—E. Isspolatow offers some remarks on the still unsettled question of fern-hybrids, and considers that certain ferns gathered by him in various parts of Russia are hybrids, namely, *Botrychium rutaceum* Willd., a hybrid of *B. Lunaria* and *B. rutæfolium*; and apparently *Cystopteris sudetica* A. Br. and M., is a hybrid of *C. montana* and *C. fragilis* or *Polypodium Dryopteris*. According to some observers, *Phegopteris Robertiana* A. Br. is to be regarded as a hybrid of *Polypodium Phegopteris* and *P. Dryopteris*.

Costa Rica Ferns and a New Climbing Fern from Madagascar.†—H. Christ continues his studies of the ferns of Costa Rica, and gives a list of 59 species collected by Pittier, Tonduz, Werckle, Biolley, and others. From Mt. Tablazo comes a group of species of *Lastrea*, related to those first found by Sodiro in Ecuador. The author has been supplied with some comparative field-notes by Werckle, who made an expedition into Colombia, and was surprised to find the flora of Colombia (except between the rivers Atrato and Cauca) to be relatively a poor one. The fact is, that the flora of Costa Rica is the most luxuriant in the American tropics. The author describes nineteen new species and some varieties. At the end of his paper he tacks on a new Columbian fern, and also a description of a new genus from Madagascar, *Lathyropteris*, a climbing fern of an absolutely new type, connected by some of its characters with *Pteris* and *Pellæa*.

American Ferns.‡—L. M. Underwood has monographed the American species of *Stenochlæna*, twelve in number, all of which would be referable to the comprehensive *Acrostichum sorbifolium* of Hooker and Baker's "Synopsis Filicum." Preferring, for strongly stated reasons, to regard them as separate species, Underwood supplies a synoptical key to aid in their separation, and describes three of them as new. References, distribution, and notes are added. Remarks are made upon five other species which require further investigation. The author also demonstrates that *Pœcilopteris crenata* Presl is not a form of *Leptochilus serratifolius*, but is closely allied to *L. contaminoides* from Paraguay, and indeed absorbs the Brazilian specimens referred to that species by Christensen. M. A. Strong § records the finding of another colony of plants of *Dryopteris Filix-mas* in Vermont, at a place six miles from where it was discovered in 1905. She describes

* Bull. Jard. Imp. Bot. St. Pétersbourg, vi. (1906) pp. 208–9.
† Bull. Herb. Boiss., vii. (1907) pp. 257–76 (fig.).
‡ Bull. Torrey Bot. Club, xxxiii. (1906) pp. 591–605 (figs.),
§ Rhodora, ix. (1907) pp. 27–8.

the environment of the plants, and gives the names of nine other ferns found in the vicinity.

Azolla filiculoides in Italy.*—A. Béguinot and G. B. Traverso allude to the rapidity with which *Azolla caroliniana*, after being introduced into botanic gardens in various parts of Europe in 1872, spread over the continent; and also trace out more fully the history of the invasion of Europe by the allied species, *A. filiculoides*, which also was introduced from America. It first established itself at Bordeaux in 1880, and spread rapidly through Gironde, threatening to oust the native water-plants; in 1888 it was reported from Cherbourg and Fécamp; in 1889 from Rennes and the Loire; in 1892 from Montpellier; in 1898 from Orne; in 1902 from Finistère. Soon after 1900 it made its appearance in Italy; in the province of Venezia in 1901, where it is sometimes associated with *Salvinia natans*, *Potamogeton lucens*, *P. crispus*, *P. acutifolius*, *Hydrocharis Morsus-ranæ*, *Elodea canadensis*, *Hottonia palustris*, *Aldrovandia vesiculosa*, *Utricularia vulgaris*; in the provinces of Padova, Rovigo, and Ferrara, in 1901 to 1906. The two species have been confused by some European botanists; and the authors emphasise the differences between them, showing that not only may they be distinguished by the sexual organs as indicated by Strasburger in his monograph, but also by their vegetative characters when the plants are, as often happens, sterile. For clearness, the differential characters are drawn up in parallel columns. They are derived from the ramification, leaf, colour, hairs, and roots.

Asplenium fontanum not an Italian Species.†—A. Goiran condemns as false the records of the occurrence of the rare fern *Asplenium fontanum* on Monte Baldo. He has repeatedly searched for the plant from 1870 to 1903 in the places indicated, and failed to find any trace of it. Long ago Pontedera and Segujer recorded and figured a fern as growing in two spots on Monte Baldo. This was interpreted by Pollini to be *Aspidium Halleri* W., that is, *Asplenium fontanum* Bernh. But, says Goiran, Pollini was wrong; and the fern is without doubt a form of the polymorphic *Cystopteris fragilis* Bernh. Pollini, indeed, corrected his error a few years later by making Pontedera's plant a synonym of *C. fragilis*; but this correction escaped the eye of Hausmann, who, in his "Flora von Tirol" repeated Pollini's original error, as also did John Ball and other authors in their respective works. A form of the plant has been found in the Euganean Hills, but neither type nor form in the districts of Vicenza, Verona, or Trent.

Bryophyta.

(By A. Gepp.)

Growth Phenomena of Mosses.‡—B. Němec discusses the question of the growth of some mosses as regards both direction and symmetry. Mosses afford good material for the study of these subjects, being small and plentiful; and though it is difficult to produce in the laboratory

* Bull. Soc. Bot. Ital., 1906, pp. 143–51. † Tom. cit., pp. 124–6.
‡ Pringsheim's Jahrb. Wiss. Bot., xliii. (1906) pp. 501–79 (33 figs.).

their natural conditions, yet this objection is of the less importance, inasmuch as the aim of the investigator is to discover the influence of external factors upon their form and growth. The author experimented on a bilateral moss (*Fissidens*) and on an orthotropous dorsiventral form (*Dicranum*). *Fissidens* is dorsiventral both morphologically and physiologically, but may become bilateral on the clinostat. The various heliotropic effects obtained by growth in the dark and also in a side light are described. The geotropic propensities of the plant under certain conditions are set forth. Similar observations were made on *Eurhynchium striatum*. *Dicranum scoparium* is orthotropically geotropic; the stem is anatomically radial, but physiologically dorsiventral; in the dark it, like *Fissidens*, puts out negatively geotropic rhizoids. Experiments with side-light and with the clinostat are described. The text is illustrated with 33 figures, and minute details are given of 42 experiments.

Gemmæ-formation in Mosses.*—W. J. Jongmans publishes his observations on the following gemmiparous mosses—*Œdipodium Griffithianum*, *Georgia pellucida*, and *Aulacomnium*. He adds further details of the life-history of *Œdipodium Griffithianum*, as compared with other Splachnaceæ, in which group it takes a rather independent position. He describes the germination of the spore of *Œdipodium*, which forms first a filamentous and then a thalloid protonema, provided at first with a two-sided apical cell. The origin and development is as in *Sphagnum*, and not as in *Georgia*, *Tetradontium*, and *Diphyscium*. Subsequently apical growth is replaced by marginal growth. The gemmæ are borne in the axils of the leaves of the mature plant, and sometimes on the base of the leaf. They have two (rarely three) apical cells, which grow out into flat thalli bearing secondary lobes, simple or branched, like those of the spore-protonema. Between the gemmæ and the young leaves arise mucilage-hairs, which are homologous with paraphyses, and, in the author's opinion, with the gemmæ. In *Georgia pellucida* the gemmæ arise directly from the two-sided apical cell, being interspersed in the apical cup of the stem with mucilaginous hairs of equal origin. The secondary lobes of the protonema arise laterally, as a rule; they may be branched and show great power of regeneration. In *Aulacomnium palustre* the author found nothing at variance with the observations of previous authors. The gemmæ are metamorphosed leaves, each gemma corresponding with an entire leaf-rudiment. In *A. androgynum* four gemmæ are found on the rudiment of the leaf, and arise from the leaf-portion of the segment; the subsequently-produced gemmæ push up between them, but arise from the stem-portion of the segment. In all the above species, except *A. palustre*, the origin of the gemmæ can be traced back to protonema-formation, and the same can be said of *Tayloria Moritzii* and some species of *Splachnobryum*.

New Splachnobryum and its peculiar Peristome.†—H. N. Dixon describes *Splachnobryum delicatulum*, a new species of moss found by G. Webster on brickwork in hot-houses at Baldersby and Harrogate.

* Ueber Brutkörper bildende Laubmoose. Inaug. Dissertation Univ. München. Nijmegen: Macdonald, 1907, 96 pp. (figs.).
† Journ. of Bot., xlv. (1907) pp. 81–85 (1 pl.).

This species was probably imported with Cattleyas from tropical America, and is of affinity with *S. Wrightii* and *S. Baileyi*, but is distinguished from all other members of the genus by having a preperistome—a series of projecting hyaline cells subtending the peristome teeth, one to each tooth, on its outer side and near its base. The author gives a detailed comparison of the structure of the peristome in this new species with the typical structure described by Philibert for *S. Boivini*. The preperistome of *S. delicatulum* is nearly homologous with what is found in some species of *Orthotrichum*. Other species of *Splachnobryum* which have been introduced into Europe with stove-plants are: *S. Wrightii* C. M., at Glasnevin, Dublin (1872), a West Indian Species; and *S. Corbieri* Ren. et Card, at Cherbourg (1902).

Mosses of Essex.* — F. J. Chittenden publishes a list of about 200 species and sub-species of Essex mosses, exclusive of Sphagnaceæ. The total would be larger but for the following reasons: that only a few parts of the county have been thoroughly explored, and much of the northern, eastern, and southern parts require to be carefully searched; that the surface of the country lacks elevation and the soils are insufficiently diversified; and that the rainfall is small and often contaminated by London smoke. In connection with this poor rainfall, the author notes that in Essex the species produce fruit far less abundantly, and are less luxuriant in their vegetative growth, than is the case in the moist western counties of England. The two chief rarities recorded for the county are *Zygodon Forsteri* and *Grimmia commutata*.

Scottish Mosses.†—J. Stirton publishes notes on some West Highland mosses, and reflections upon the problems which they suggest. The specimens were gathered at Arisaig, on the west coast of Scotland. *Myurium hebridarum* has only once before been found on the mainland. It occurs in the Faroe Islands, along the whole chain of the Outer Hebrides, in the Azores, and, it is reported, from the Canaries and St. Helena, and nowhere else in the world. It has never been found in fruit, and hence its capacity for spreading is very limited. Its distribution argues strongly in favour of a former land connection of all these islands. Remarks are added on the distribution of *Hedwigidium imberbe* and on *Dicranum Fergussoni*, which the author thinks to be clearly in process of evolution and differentiation from *D. Scottianum*.

North American Muscineæ.—N. C. Kindberg‡ gives lists of 80 mosses collected by N. L. T. Nelson, mostly in Missouri and Minnesota. Six species and two sub-species are described as new. E. G. Britton§ has made a study of *Rhacopilum tomentosum*, a tropical American species which has also been found in the United States, in Louisiana. This plant and the type she figures, and also provides a new description for the species. A. Lorenz‖ records the discovery of *Lescuræa frigida* on Mount

* Essex Naturalist, xiv. No. 7 (1906) pp. 204–35.
† Ann. Scott. Nat. Hist., 1907, pp. 42-5.
‡ Rev. Bryol., xxxiv. (1907) pp. 25-9.
§ Bryologist, x. (1907) pp. 32–3 (1 pl.). ‖ Tom. cit., pp. 34–5.

Mansfield, Vermont. It had been previously gathered in northern Labrador by Macoun in 1896, and described by Kindberg.

Swiss Mosses.—C. Trautmann* describes a few of the mosses collected by him in the Bernese Oberland, of which the most interesting and important was *Orthotrichum perforatum* Limpricht. This was originally found growing plentifully in one locality in Tyrol, and also in Styria. It is here recorded from four different situations in the Bernese Oberland, all above 2000 m., where it is not at all plentiful. The author finds it a very variable species, the only part of it which remains constant being the calyptra. With *O. perforatum* was growing *O. Sardagnanum* Vent.; and other rare and interesting species are recorded.

Ch. Meylan† last year searched the Jura mountains of Berne and Soleure, and succeeded in adding four genera and twelve species to the Jura flora. Six of these species are alpine. The erratic blocks of the district have yielded some interesting species. The list contains 70 mosses and 26 hepatics.

Mosses of the Erzgebirge.‡—J. Röll gives a summary of the results obtained by him from a study of the moss-flora of the Erzgebirge during a period of thirty-two years. First he enumerates the stations visited and the principal species gathered at each in the different years. He then reviews briefly all the papers which he has himself published in connection with this subject, and also the publications relating thereto of Schiffner, Bauer, and Mönkemeyer. He defends himself against the criticisms of Warnstorf, and maintains that the right principle of working is to study the plants in the field rather than in the herbarium, and to take into account the innumerable forms and connecting links between the so-called types. He then supplies a list of the species recorded for the Erzgebirge, with their localities; and a similar list of Sphagnaceæ, in great detail of varieties and forms. The moss-flora of the Erzgebirge is less rich than that of the Fichtelgebirge or the Harz, and the Saxon part of the range is less rich than the Bohemian watershed.

Mosses of the Austrian Protectorate.§—J. Glowacke publishes the second part of his bryological contributions from the protectorates of Bosnia and Montenegro. He gives lists of the mosses collected in 23 additional localities, indicating the height above sea-level and the geological nature of the soil where each collection was made.

Bryophytes of Majorca.—W. E. Nicholson‖ publishes lists of 78 species of mosses and 9 hepatics gathered by him in Majorca during a short visit in June, 1905. The phanerogamic flora is remarkable as containing three per cent. of endemic plants; but the moss-flora presents no such peculiarity. Under the influence of the very dry climate the species are few, even in the mountains, and tend to the xerophytic type; and there is apparently a total absence of the genera

* Hedwigia, xlvi., (1907) pp. 182–4.
† Bull. Herb. Boiss., vii. (1907) pp. 237–46.
‡ Hedwigia, xlvi. (1907) pp. 185–245.
§ Verh. k.k. Zool-bot. Gesell. Wien, lvii. (1907) pp. 19–33.
‖ Rev. Bryol., xxxiv. (1907) p. 1–6.

Polytrichum, *Rhacomitrium*, *Dicranum*. The author's researches add 43 mosses and four hepatics to the lists given by Barcelo y Combis in his "Flora Balear" (1879–81).

Webera subannulata.*—P. Culmann, having previously announced that No. 826 of Husnot's "Musci Galliæ exsiccati" does not belong to *Webera lutescens*, but to *Mniobryum vexans*, now finds that Philibert described the plant as a new species, *W. subannulata*, intermediate between the genera *Webera* and *Mniobryum*, but overlooked by most authors. Culmann rejects Roth's view that *W. subannulata* is identical with *W. pulchella*, but admits the close relationship between *M. vexans* and *W. pulchella*, which has been insisted upon by Loeske.

Mosses of the German Antarctic Expedition.†—V. F. Brotherus publishes an account of the mosses collected by the German South Polar Expedition. A total of 61 species is given. The 50 species from Kerguelen include 12 new to the island and 9 new to science. The five from Heard Island (new records) include one new to science. From Possession Islands, in the Crozets, 12 are recorded for the first time, three being new to science. One new species came from Gaussberg (66° 48′ S. lat., 89° 19′ E. long.). The author gives a brief résumé of previous collections in Kerguelen. The first was that of Sir Joseph Hooker in 1840, 25 species. In 1874 three expeditions visited the island for the transit of Venus:—Kidder's collection was named by James in America (28 species); Moseley and Eaton's named by Mitten (37 species); Naumann's named by C. Müller (79 species). Though the apparent total of these four collections amounts to 144 species, it is misleading, because of the very different conceptions of species-limitations held by the bryologists who determined the collections.

Mosses of Spitzbergen.‡—I. Thériot gives a list of 10 mosses collected in Spitzbergen by Lorentz in 1906. They are mostly of an arctic type, modifications of European species. For instance, *Ceratodon arcticus* Kindb. is a sub-species of the common *C. purpureus*; two varieties of *Aulacomnium palustre* occur, one of which has the alar cells of its leaves inflated and coloured, and practically links up *A. papillosum* Lesq. and James with *A. palustre*. *Hylocomium splendens* var. *gracilius* Boul. appears to take precedence of var. *alpinum* Schlieph.

Muscineæ from Manchuria.§—V. F. Brotherus publishes a list of 66 mosses and 7 hepatics (these being named by Stephani) collected by P. Siuzew, a Russian officer, in Manchuria and the region of the river Ussuri. Two of the pleurocarpous species are described as new. No previous record of Eastern Manchurian mosses is known.

Mosses collected in Annam and China.‖—E. G. Paris gives a list of 10 mosses and an hepatic gathered at Langbian, in Annam, by

* Rev. Bryol., xxxiv. (1907) p. 6.
† Deutsch. Südpol. Exped., viii. Bot. (1907) pp. 81–96 (2 pls. and figs.).
‡ Rev. Bryolog., xxxiv. (1907) pp. 36–7.
§ Trav. Troïtsk. Kiakhta Sect. Amur Soc. Imp. Russe Géogr., viii. No. 3 (St. Petersbourg, 1907) 10 pp.
‖ Rev. Bryolog., xxxiv. (1907) pp. 31–3.

Eberhardt. Two of the species are new. He also gives a list of 13 mosses collected near Shanghai by Henry and Courtois, five of which are interesting as having been recorded from North Shen-si.

Orthomniopsis and Okamuræa.* — V. F. Brotherus publishes descriptions and figures of two new genera from Japan. *Orthomniopsis* is a remarkable genus allied to *Orthomnion*, but very different from it in the structure of its peristome. It has one species, *O. japonica*, collected by Okamura on Mt. Kuishi, Tosa province, Shikoku. The other novelty is *Okamuræa*, a most distinct genus, nearest to *Forsstroemia*, but quite different in the structure of its peristome. Its one species, *O. cristata*, was gathered in the same Japanese province.

True Status of Philonotis mollis Vent.†—G. Desmier is preparing a monograph of the French species of *Philonotis*. In studying *P. mollis* Vent. he has discovered that most authors have misunderstood that plant, probably through never having seen authentic specimens of it, and have regarded it as a variety of *P. calcarea*. He recapitulates their views. He then shows that *P. mollis* is synonymous with *P. cæspitosa*, as had been indicated already by Venturi and by Husnot. *P. cæspitosa* was first found and described by Wilson in this country, and is not known from any but silicious habitats, whereas *P. calcarea* is essentially calcicolous. Dismier defines the distinctive characters of the two species.

Ephemerum stellatum Phil.‡—I. Douin states that he has recently gathered this very rare little moss at five stations in France, and that consequently it is less rare than has been supposed. It escapes notice through being so minute. It grows on the silicious clay, upon which he has found such other curious rarities as *Prionolobus dentatus*, *P. Turneri*, *Cephaloziella Douinii*, *C. gracillima*, *C. Bryhnii*, *Dichiton gallicum*. It is usually accompanied by *E. serratum* and *E. stenophyllum* var. *brevifolium*. *E. stellatum*, originally discovered in France by Philibert, was gathered by W. E. Nicholson at Crowborough, in Sussex, and at Bedgbury, in Kent, in 1902.

Weissia brasiliensis, a forgotten Species.§—I. Thériot has studied the type of *Weissia brasiliensis* Duby, a moss which was collected at Bahia by Salzmann. It was described in 1836, but has remained almost forgotten for half a century, and its name has been invented afresh for another moss. Thériot realised at once that it belongs to a section of *Microdus*, and later found that it is identical with *M. pomiformis* Besch., an Indian species originally named *Didymodon pomiformis* by Griffith in 1840. According to the Vienna rules of nomenclature, the species takes the name of *Microdus brasiliensis*, though its principal habitat is in Asia—Himalaya, Khasia, Ceylon, Java. Thériot gives a new drawing of the Brazilian plant, but says Duby's figure is good so far as it goes.

* Oefv. Finsk. Vet. Soc. Foerh., xlix. No. 10 (1906) 4 pp., 2 pls.
† Rev. Bryolog., xxxiv. (1907) pp. 33–6. ‡ Tom. cit. p. 24.
§ Bull. Herb. Boiss., vii. (1907) pp. 277–8 (1 pl.).

Thamnium Lemani, a Deep-water Moss.* — F. A. Forel has received new specimens of *Thamnium Lemani* Schnetzler, a moss which, strangely enough, grows submerged at a depth of 200 feet in the Lake of Geneva, on the south side of the lake, off Yvoire (Haute-Savoie). They were dredged up in November 1906, in good vegetative condition, and rooted to stones. This moss is the only known instance of a green plant that vegetates at so great a depth in fresh-water, and is a proof of the great depth to which daylight penetrates into water. It is a derivative of the common species *Thamnium alopecurum*.

Some Critical Species of Pohlia.†—H. Busch treats of some species of *Pohlia* which have recently undergone critical investigation :—*P. grandiflora* Lindb. fil., *P. proligera* Lindb., *P. annotina* Lindb., *P. bulbifera* Warnst.; and he supplies a key for their determination. He also calls attention to *Mnium annotinum* Leers, described in 1775, and synonymous with *Pohlia annotina* Warnst., and *Webera Rothii* Correns.

Classification of the Harpidia.‡—F. Renauld continues the article in which he describes the principles adopted by him in classifying this difficult group of mosses. In a series of critical notes he treats of the various species and forms, their relationships and distribution, the modifying effect produced upon them by soil, climate, altitude, etc. He urges that the forms should be studied in the field, rather than in the herbarium. It is thirty years since he began to study this group, at which time Schimper's "Synopsis" was the only book that treated the group with any certainty; it did not, however, go into details. The further development has been elaborated mainly by Renauld and by Warnstorf in their respective systems of classification.

Sphagnological Notes.§—J. Röll publishes a series of critical notes on the results of recent researches upon the Sphagnaceæ, especially the work done by Warnstorf and by Roth. He discusses innumerable points of detail and differences of opinion. He asks, *inter alia*, what the old *Sphagnum acutifolium* Ehrh. ought to be called, now that *S. rubellum* Wils., *S. fuscum* Klinggr., *S. Schimperi* Röll, *S. robustum* Röll, *S. plumulosum* Röll, *S. Warnstorfii* Röll (*S. patulum*), *S. Girgensohnii* Russ., *S. Warnstorfii* Russ., and *S. subtile* Warnst., have been split off from it. He treats of the difficulties of the *cuspidata* group, and of the still greater difficulties that beset the *subsecunda* group. The members of this group he arranges in tabular form, with a brief key.

Index of Mosses.||—E. G. Paris's Supplement to his "Index Bryologicus," which was published in 1900 as a Mémoire of the Boissier Herbarium at Geneva, has been distributed, by the generosity of the aforesaid Herbarium, as a free supplement to the first number of this

* Arch. Sci. Phys. Nat. Geneva, xxiii. (1907) pp. 208–9.
† Medd. Soc. Faun. Flor. Fenn., 1905–6, heft 32, Helsingfors, 1906.
‡ Rev. Bryol., xxxiv. (1907) pp. 7–14.
§ Oesterr. Bot. Zeitschr., lvii. (1907) pp. 96–106.
|| Geneva: Georg. 1900, 334 pp.

year's "Revue Bryologique," for the benefit of the subscribers of that periodical. It treats of the moss-flora of the whole world.

Twin Capsules in Mosses.*—I. Györffy describes and figures an instance of twin capsules arising on one seta in *Plagiobryum demissum* Lindb. This phenomenon has been noted previously for other species, but not hitherto for *P. demissum*. The author found it on the Stierberg, in the Hohe Tatra. He gives a description of the plant, and agrees with Leitgeb in considering that in these cases the one sporangium has been, as it were, split off from the other. He gives a list of localities where he has found *P. demissum* in the Hohe Tatra. An instance of a double capsule is also recorded in *Polytrichum juniperinum*; in that case, however, the two capsules have each their separate seta, but are covered with a common calyptra. In both these instances the double capsule arises from a single egg-cell.

European Hepaticæ.†—K. Müller issues the third fascicle of his monograph of the Hepaticæ in Rabenhorst's "Kryptogamen-flora." He brings to an end the introductory remarks which occupied the first two fascicles, adding a list of the more important published sets (exsiccatæ) of European Hepaticæ, with their dates, etc. This is followed by a list of the herbaria of the principal deceased experts in hepaticology, with information as to where these herbaria are preserved. In discussing the systematic arrangement of the hepatics, he briefly states the main divisions of the group adopted by previous authors; and contrasts in tabulated form the systems employed in Gottsche, Lindenberg, and Nee's "Synopsis Hepaticarum" (1844), Lindberg's "Hepaticæ in Hibernia lectæ" (1875), and Leitgeb's "Untersuchungen über die Lebermoose" (1874–81). In introducing his own systematic treatment as followed throughout the present work, he declares his preference for condensed rather than exhaustive diagnoses. Beginning with the sub-class Marchantiales, he gives a key to the genera of Ricciaceæ, followed by an introductory account of the morphology of the genus *Riccia*, illustrated by figures, and containing a useful list of hints concerning the special points to be noted in determining the species of *Riccia*. To this is appended a synoptical key of the 39 European species of this genus, followed by a detailed key of the 26 species of Middle Europe. The descriptions of the species are modelled on those of Limpricht's "Laubmoose," the recently completed fourth section of Rabenhorst's "Kryptogamen-flora;" the species which inhabit Germany, Austria, and Switzerland are treated in ordinary type, while those that occur outside these three countries are described in small type. The descriptions are illustrated by figures in the text, and a detailed distribution is appended.

Scottish Hepaticæ.‡—S. M. Macvicar adds 125 records to his previously published lists of Scottish Hepaticæ. Among them are three additions to the Scottish flora:—*Lophozia badensis* Schiffn., *Prionolobus*

* Hedwigia, xlvi. (1907) pp. 262-4 (figs. in text).

† Rabenhorst's Kryptogamen-Flora. VI. Lebermoose, lief. 3. Leipzig: Kummer, 1907, pp. 129-192 (figs.).

‡ Ann. Scott. Nat. Hist., 1907, pp. 45-9.

striatulus Schiffn., *Cephaloziella Limprichtii* Warnst. The *Lophozia badensis* had been confused with *L. turbinata*. Some other interesting records are: *Anthelia julacea*, *Hygrobiella laxifolia*, *Gymnomitrium adustum*, *Pallavicinia Flotowiana*, *Lophozia atlantica*, *Sphenolobus Pearsoni*, *Anastrepta orcadensis*.

Hepaticæ of Porto Rico.*—A. W. Evans, continuing his study of the Hepaticæ of Porto Rico, treats of the four genera *Stictolejeunea*, *Neurolejeunea*, *Omphalanthus*, and *Lopholejeunea*. The type of *Stictolejeunea*, *S. squamata*, is widely distributed in the American tropics. It was originally recorded as found on myrtle bark from the East Indies and subsequently as from Hawaii. These records, however, have never been confirmed, and must be regarded as false. The genus is remarkable for its Frullanioid branching and for the ocelli with which its leaves are spotted. In *Neurolejeunea* two of the three species have a false nerve (a row of ocelli) in their leaves. A fourth species, which links up this genus with *Ceratolejeunea*, is here transferred to the latter genus, to which its affinity is the stronger. The two genera are separated by characters derived from the leaf-cells, lobules, and perianths. In *Neurolejeunea catenulata* and *Ceratolejeunea portoricensis* the apices of the leaves are sometimes curiously scarious or lacinulate with hyaline cells, which apparently aid the plant in clinging to the substratum. The genus *Omphalanthus* is represented by a single species widely distributed in tropical America, and of doubtful occurrence elsewhere. *Lopholejeunea* is a larger genus, characterised by its sharply keeled and laciniate perianth, and is represented by more than thirty species mostly found in the tropics. Six of these occur in America, and three of these are found sparingly in Porto Rico, one being new to science. All the plants in this paper are redescribed in full detail and freely illustrated.

Hepatics of Tuscany.†—E. Barsali has compiled a list of 37 species of hepatics with their distribution in Tuscany. It is as far as possible exhaustive, and is preceded by a general introduction in which the geographical distribution of these plants is discussed. Some species prefer a calcareous soil, others a silicious soil; others again abound on the trunks of trees in damp neighbourhoods; others are found in stagnant or running water. In the Tuscan plains the species are few, chiefly thalloid forms. In the olive groves of the lower hills, especially near water, more species are found. But it is in the region of chestnut and oak forests that most of the species occur, on the ground, on rocks, on living or dead trunks, or indifferent as to their substratum. From altitudes of over 5000 feet some twenty-two Alpine species are recorded.

New Madotheca from China.‡—C. Massalongo gives a diagnosis of *Madotheca nitidula*, a new Chinese hepatic collected in Shen-si by Giraldi. It was too late for inclusion in E. Levier's paper on Giraldi's Shen-si Bryophytes published recently in the Nuovo Giorn. Bot. Ital.

* Bull. Torrey Bot. Club, xxxiv. (1907) pp. 1–34 (4 pls.).
† Nuov. Giorn. Bot. Ital., xiv. (1907) pp. 5–49.
‡ Bull. Soc. Bot. Ital., 1906, p. 141.

Lophocolea minor Not a Good Species.*—I. Douin has made a prolonged and detailed study of *Lophocolea minor* and *L. heterophylla*. As to the differences that distinguish the two plants, he has extracted the views of all the authors who have described both the species, and has reduced them into two parallel columns. He then proceeds to discuss in detail the distinctive characters indicated by these authors, which indeed are sometimes contradictory. The conclusion to which he comes is that *L. minor* is not a good species, but is the young form of *L. heterophylla* arrested in its development and almost always having its leaves eroded and deformed by propagules, in consequence of such unfavourable conditions as calcareous soil, drought, etc.; also that according to external conditions of drought and prolonged humidity the same plant may, as it grows, pass from the state of *L. minor* to that of *L. heterophylla*, and vice versâ. The author gives a careful description of *L. heterophylla*, and to its var. *minor* he relegates *L. minor* Nees.

Ricciella Huebneriana.†—V. Torka gives some notes on the biology of *Ricciella Huebneriana*. Cultures show that it cannot survive the winter in a floating state, but must be submerged. In the spring it breaks loose, rises to the surface, and, reaching the edge of the swamp, can strike root and produce new plantlets.

Various Notes on Hepaticæ.‡—V. Schiffner publishes a further series of bryological notes. His *Cephaloziella Baumgartneri*, published last year as a native of Dalmatia and the south of France, is found to have a wider distribution, having been gathered in Crete by W. E. Nicholson, and in Sussex by the same collector. This is another instance of the occurrence of calcicolous Mediterranean plants in the south of England. It has also been found near Verona; and from near Florence *Cephalozia patula* has been described, which is a shade-form of the same species. In another note Schiffner records new stations for six exotic Hepaticæ, interesting from the point of view of distribution. Further notes treat of the occurrence of *Scapania obliqua* in Norway, and of the discovery in Saxony of the Scandinavian *Lophozia grandiretis*.

Calypogeia and its Type-species.§—A. W. Evans discusses the question of the priority of the generic name *Calypogeia* over *Kantia* and *Cincinnulus*. Raddi's *Calypogeia*, published in 1818, contained two sections: A, two species without underleaves, *C. ericetorum* and *C. flagellifera*; B, one species with underleaves, *C. fissa*. Ignorant of this and also of one another's work, S. F. Gray and Dumortier respectively published *Kantius* (1821) and *Cincinnulus* (1822), each of which corresponds with Raddi's section B. Synonymous with this is the *Calypogeia Trichomanis* of Corda (1829). In 1836 Nees von Esenbeck retained *Calypogeia* for Raddi's section B., and proposed for section A the name *Gongylanthus*. Lindberg, however, in 1875 restored *Calypogeia* to section A, and adopted *Kantia* for section B. Since then there has

* Rev. Bryolog., xxxiv. (1907) pp. 14–23.
† Helios., xxxiii. (Berlin, 1906) pp. 105–7 (3 figs.).
‡ Oesterr. Bot. Zeitsch., lvii. (1907) pp. 48–51, 89–91.
§ Bryologist, x. (1907) pp. 24–30.

been still more lack of uniformity. The settlement of the controversy depends upon which of Raddi's three species is to be considered the type. Levier contends that the third species, *C. fissa* Raddi, must be retained in the genus *Calypogeia*, because one of its synonyms quoted by Raddi is *Jungermannia Calypogea* Raddi (1798), which supplies the characters and even the name to the genus, and hence ought to be regarded as its primordial type. Evans supports this view, and claims that Article 45 of the new Rules of Nomenclature adopted at Vienna confirms it. In that case *Calypogeia* stands for Raddi's section B; and *Gongylanthus* stands for section A. With *C. fissa* taken as the type of *Calypogeia*, a fresh set of difficulties has to be encountered; for *C. fissa* has been interpreted in very different ways by various European writers. To settle this point it is necessary to go back to the *Mnium fissum* and the *M. Trichomanis* of Linnæus and to the pre-Linnæan descriptions, drawings, and specimens of Dillenius. Lindberg saw these latter 30 years ago and reported on them thrice, but unfortunately with variation of opinion. Evans is unable to accept Lindberg's interpretation of them save with reservation, as Lindberg relied too much upon that variable character, the inflorescence. Evans adduces reasons for the rejection of the name *Kantia Sprengelii*, as used by recent British authors for *C. fissa* of Raddi. For himself he fully accepts *C. fissa* as a species, and draws up a long synonymy for it. It is closely related to *C. Trichomanis*, a very variable plant for which it has probably often been mistaken.

Morphology and Development of Frullania and Jubula.*—F. Cavers gives an account of the morphology and life-history of *Frullania* and *Jubula*, chiefly based on the common *Frullania dilatata* and *F. Tamarisci*, which grow the former on trees, the latter on rocks. The range of the genus *Jubula* is remarkable. Its one species was first discovered in Ireland, and later at a few stations in the West of England, Wales and Scotland. It occurs nowhere else in temperate regions, but has a wide distribution in tropical America. The author describes the characteristic form of the leaves of *Frullania*, with their lobulus and stylus, tracing them back to their rudiments and so to the apical cell. The origin of the branches is explained; and the position and structure of the inflorescences and reproductive organs are made clear. The sequence of the cell-divisions in the development of the sporogonium is described, and the subsequent development up to the bursting of the capsule, also the germination of the spore and formation of the young plant.

BROTHERUS, V. F.—[**Japanese Mosses.**]
[A list of 50 mosses, five of which are new, but without descriptions. Japanese text.] *Tokyo Bot. Mag.*, xx. (1906) pp. 214–15.

STEPHANI, F.—**Species Hepaticarum.** (Species of Hepatics.)
[A continuation of his monograph of *Lophocolea*, including descriptions of 31 species, eight of which are new to science.]
Bull. Herb. Boiss., vii. (1907) pp. 297–312.

* Naturalist, Nos. 600–1 (1907) pp. 11–16, 46–49 (5 pls.).

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Phylogeny of Algæ.*—J. P. Lotsy publishes a series of lectures on Botanical Phylogeny, delivered by him in the Universities of Leiden and Utrecht. The work is to be completed in three volumes; the first of these deals with the Algæ and Fungi. The author begins with a general genealogical tree of the entire plant world, starting from the common origin Protomastigina, and, working through various groups, arrives finally at Myxomycetes, Fungi, Flagellatæ, Charophyta, and Spermaphyta. The details of these main lines of development are worked out step by step in the text, so far as algæ and fungi are concerned. The book is plentifully illustrated, and lists of literature applying to each lecture are given at the end of the work.

Morphology of Lower Algæ.†—G. Nadson publishes a preliminary communication on this subject, in which he deals with three points: 1. On alterations in *Stichococcus bacillaris* Näg. caused by necessities of nutrition. 2. Formation of endospores in *Stichococcus bacillaris* Näg. and *Chloroïdium Krügeri* (*Chlorothecium saccharophilum* Krüger) Nads. 3. *Chlorobium limicola* Nads., a green chlorophyllous microbe. In the first note the author details the effect of certain nutritive solutions on cultures of *Stichococcus bacillaris*, and points out that the different forms assumed by this species have been regarded by authors as representing other species and even genera. The formation of endospores in pure cultures occurred as the result of unfavourable conditions of life. The cell-contents (either all or a part) shrivel up and form a colourless endospore, which surrounds itself with a membrane. When germination takes place the spore swells up, and, without throwing off the membrane, becomes gradually a young algal cell. In *Chloroïdium Krügeri* the new chromatophore is not developed from the leucoplast, but arises by a condensation of part of the protoplasm, at the same time becoming green. The paper is in Russian, with a German résumé.

Germinating Plantlets of Florideæ.‡—F. Tobler gives a short account of the germination of some of the Florideæ. In the material which he has examined he distinguishes three types: (1) The upright type of Ceramio-Rhodomeleæ; (2) the disk or horizontal type; (3) the hemispherical type. The species here described in detail are *Griffithsia opuntioides*, *Plocamium coccineum*, *Gigartina Teedii*, *Polysiphonia urceolata*, and *P. variegata*. *Griffithsia* belongs to the simple *Ceramium* type, but the other three genera are more complicated. One feature, however, is common to all three, and that is that at some given moment sooner or later, a process of active cell-division takes place without any special increase in size. A more or less shapeless mass of cells is formed, and from this a shoot arises; the cell-mass does not itself

* Vorträge über Botan. Stammesgeschichte. Jena: Fischer, i. (1907) iv. and 828 pp.

† Bull. Jard. Imp. Bot. St. Pétersbourg, vi. (1906) pp. 184–94.

‡ Beih. Bot. Centralbl., xxi., 1te Abt. (1907) pp. 148–55 (1 pl.).

become transformed into the normal thallus. Details of the germination of other species are discussed, and the work of Oltmanns and Derick is commented upon.

Marine Algæ from the Chatham Islands.*—A. D. Cotton publishes a list of 42 species from these islands, collected by H. E. Maltby. One of these is new, *Rhodophyllis chathamensis*, most nearly allied to *R. Brookeana*, but differing from it in the structure of the frond. The algal flora of the islands bears a strong resemblance to that of New Zealand.

Algæ of the Chatham Islands.†—E. Lemmermann writes a full account of the algal flora of the Chatham Islands, in which he includes all the species, both fresh-water and marine, which have been recorded from there up to the present time. The first collection was made by H. H. Travers and worked out by von Mueller and J. G. Agardh. It included 75 species. Nothing further happened till the voyage of Schauinsland, whose collection has greatly enriched our knowledge of the algæ of the islands. The marine species were worked out by Reinbold and the fresh-water species by Lemmermann, who now writes a general survey of the entire algal flora. The total number of species now recorded from the Chatham Island group is 177, of which 102 are new records, including 8 new to science. In tabulated form is shown the number of species belonging to each group, followed by lists of the species found in Lake Huro and the Lagoon, with notes on their frequency, etc. The greater number of algæ collected are marine and belong especially to Florideæ. Of the whole marine flora, 32 are cosmopolitan and 15 are endemic species, while many of the remainder are as yet only recorded from New Zealand and the Chatham Islands: these are enumerated in separate lists. The main characteristics of the Chatham Islands algal flora are: the occurrence of the large Phæophyceæ (*Durvillæa*, *Marginaria*, *Macrocystis*), the preponderance of Florideæ (74 species), the poor development of Chlorophyceæ, and the occurrence of the 15 endemic species. A list is then given of all the species, fresh-water and marine, with the locality and geographical distribution of each; together with a few critical notes and keys.

Algæ of Central Europe.‡—W. Migula continues his work on the algæ of Germany, Austria, and Switzerland, which forms the cryptogamic part of Thomé's "Flora von Deutschland." About half of the cryptogamic portion is now completed. The algæ have been carried on in the present five parts from the middle of the Desmideæ to the family of the Scenedesmaceæ. There are, as usual, keys to the genera and species, and descriptions are given of each species.

New British Callymenia.§—E. M. Holmes describes a new species of *Callymenia*, *C. Larteriæ*, collected at Combe Martin, in North Devon, by Miss Larter. The colour of the frond is duller than that of the typical form of *C. reniformis* or of its var. *undulata*. In no specimen

* Kew Bull., 1907, pp. 37–43.
† Engler's Bot. Jahrb., xxxviii. (1907) pp. 343–382 (2 pls.).
‡ Gera: Zezschwitz, 1907, lief. 35–39, pp. 513–672 (25 pls.)
§ Journ. of Bot., xlv. (1907) pp. 85–6.

has the author seen prolifications which attain the size of the original frond. The plant bears cystocarps throughout the year, scattered over the whole frond, except on the young prolifications. Notes are given on the three forms of *C. reniformis*.

Cymathere triplicata.*—R. F. Griggs gives a detailed account of the habit and structure of this alga from the north-west coast of America. As regards its habitat, it seeks quiet secluded nooks out of the reach of the surge, and it does not succeed well except in situations which are never uncovered by the tides. It may reach a length of 4 m. and a breadth of 22 cm., though most plants are smaller than this. The sporangia occur at the base of the lamina on both sides, and they extend much further up the grooves than on the ridges of the plicæ. The stipe is wholly without mucilage ducts of any kind, while in the lamina there occurs an irregular circle of openings which may be considered mucilage ducts, although they do not possess any lining wall of special secreting cells. Indeed, these openings appear more like a breaking down of certain cells, and may perhaps be the beginning of degeneration. The inner cortex is developed into thick-walled strengthening tissue, as is usual in the family, and it is of this tissue that the ribs on the folds are composed. In the pith-web the hyphal elements are very short, and the trumpet-hyphæ are very scarce and poorly developed. The holdfast is simple, and the paraphyses are linear and unthickened, which, together with the simplicity of the structure in other ways, would point to a branching-off from the main phylum of the Laminariaceæ at an early date in their development. The long persistence and large size of the one-layered primary lamina is a noteworthy feature.

Newfoundland Desmids.†—J. A. Cushman records seventy-two species, belonging to seventeen genera, as the result of collections made at three points in the island, fairly remote from each other. Some of the species were not previously known from North America, and, with the exception of a certain number published by the author in November 1904, and included here, all the species in the present list are new to Newfoundland.

Yorkshire Diatoms.‡—R. H. Philip publishes a few notes on the most interesting gatherings of diatoms, made in Yorkshire during 1906. In all eighteen species and one variety are recorded, and seven of them are figured. Curiously enough, *Coscinodiscus radiatus*, a marine species, was found, well above high-water mark, in a fresh-water stream which falls into Little Thornwick Bay.

Œdogoniaceæ.§—A. Pascher writes his views on the dwarf male plants of Œdogoniaceæ, summarising previous literature on the subject, and criticising the statements of Hirn. The view held by that author, that the nanandrous forms had arisen from the makrandrous forms, seems to Pascher unlikely. The androzoospores, or androspores of

* Ohio Naturalist, vii. (1907) pp. 89–96 (1 pl.).
† Bull. Torrey Bot. Club, xxxiii. (1906) pp. 607–15.
‡ Trans. Hull Sci. Field Nat. Club, iii. (1907) pp. 291–2 (figs.).
§ Hedwigia, xlvi. (1907) pp. 265–78.

Pringsheim, arise from zoospores, and form intermediary swarm-spores between zoospores and spermatozoids; from these androspores are formed later the spermatozoids. The dwarf males of the Œdogoniaceæ are analagous to the dwarf germinating plants of Chætophoroidæ; their special sexual character is connected with the highly-developed sexual differentiation of the Œdogoniaceæ. The gynandrous and makrandous-diœcious forms stand on a higher plane than the nanandrous, which, being on a lower level of sexual differentiation, require the help of the dwarf male in order to reach the same degree of sexual differentiation. The Œdogoniaceæ show a closer connection with the chætophoroid than with the ulotrichoid Ulotrichales.

Ceylon Species of Caulerpa.*—N. Svedelius publishes the first of a series of papers dealing with the marine flora of Ceylon. The present contribution is an ecological and systematic study of the Ceylon species of *Caulerpa*, in which the subject is treated under the following main headings. (1) Introduction. (2) On the mode of life of the Caulerpas. (3) On the different kinds of variation in Caulerpas. (4) Taxonomy; definition of the species. (5) On the geographical distribution. (6) List of the species described. As to the ecological conditions of the various species, the author finds that in a preponderating number of cases the substratum consists of firm, rocky coral ground; but very commonly, too, *Caulerpa* grows on soft bottom, in sand, in coarse gravel, or even in soft mud carried out to sea by rivers, etc. He discusses different ecological types, as distinguished by varying developments (1) of the root-system, (2) of their assimilation system. After some remarks on the difference between morphological and adaptational characters in *Caulerpa*, the author describes the different kinds of variation in the genus, of which he recognises six. Passing on to the taxonomy of the species, he states his view that narrow, rather than broad, species-limits tend to clearness; and following out these lines, he describes twenty-one species (among them two novelties) as occurring in Ceylon. Certain species which had been sunk into varieties of other species are revived once more, and many new forms are defined and figured. The geographical distribution of the genus is treated very thoroughly under the headings of distribution (1) of the Caulerpas in Ceylon; (2) of the Ceylon Caulerpas in other places; and (3) of Caulerpas in general. Under the last section, the interesting fact is pointed out that of the 50–60 species known, 12 are common to the tropical Atlantic and the Indian-Pacific Ocean, being about half the sum total of the Ceylon species. No species occur along the South American coast, and the Cape flora is very poor in this genus, so that there is no station between these widely separated points, the West Indies and Ceylon, which has a similar *Caulerpa* flora. It is difficult to account for this fact, and the author suggests the possibility of a prehistoric passage between North and South America, in the position of the present Isthmus of Panama.

Algological Notes.†—M. Möbius describes a "breaking of the waters" in Frankfurt-am-Main, composed of three species of Cyano-

* Ceylon Marine Biological Reports, No. 4 (1906) pp. 81–144 (51 figs. in text).
† Hedwigia, xlvi. (1907) pp. 279–87 (6 figs. in text).

phyceæ, *Oscillatoria Agardhii* Gomont., *Anabæna flos-aquæ* Bréb., and *Clathrocystis aeruginosa* Henfrey. The algæ are described, and the author states that, although the association of *Clathrocystis* and *Anabæna* has often been noted, the combination of these with *Oscillatoria Agardhii* to form a "breaking of the waters" is a new record. He mentions two other instances of the "breaking" in waters near Frankfurt-am-Main, formed by *Botryococcus Braunii* and *Chromulina Rosanoffii* respectively.

The second note in this paper consists of a detailed description of a form of *Cladophora crispata* Kütz., which grew in an aquarium with *Isoëtes lacustris*. The principal variations from the typical form consisted in numerous ring-shaped constrictions of the cells, and in a rich growth of rhizoids. The possible causes of this irregularity are discussed.

Fresh-water Algæ of Brandenburg.*—E. Lemmermann publishes the first instalment of his contribution to the Cryptogamic flora of the Mark Brandenburg. He undertakes the treatment of the algæ, and begins his work with a general account of the Schizophyceæ. This is divided into sections and treated with considerable detail, including remarks on parasites, symbiosis, polymorphism, etc. Then follows a list of literature, in which 111 works are cited. In the systematic part the author gives keys to the orders, families, genera, and species, with a short diagnosis of each species, followed by the habitat and the distribution in Brandenburg. Synonymy, references to literature, and exsiccatæ, are often given as well.

Algæ of Roumania.† — E. C. Teodoresco publishes a list of the algæ, both fresh-water and marine, of Roumania, and adds many critical notes of great interest. A few authors have published records from time to time of algæ found in Roumania, but no complete list has ever yet appeared. The present author does not complete his work in this paper, as he leaves out the Diatoms and some of the Schizophyceæ; but he proposes to study these groups very shortly. The species here recorded were collected from many different parts of the country, but the majority of excursions were made in the neighbourhood of Bucharest, Jassy, and Dobrogea. The author collected principally in the plains and lower hills, but a certain number of plants were collected in the Prahova district up to a height of 2500 m., in the district of Neamt up to 1900 m., and in the district of Gorj up to about 2200 m. As regards the marine species, they were found on the shores of the Black Sea, between Mangalia and Portita, and on the edges of the salt lakes Razelm and Babadg. Except for this stretch of shore of the Black Sea, all the coast belonging to Roumania is formed of sand, and is therefore barren of algæ. Several localities are mentioned in the rocky region as being good for marine algæ, but the richest flora is found at Constanta.

Flora of Swiss Alpine Lakes.‡—Tanner-Fullemann concludes his report on the cryptogamic flora of the Alpine lakes by a study of

* Kryptogamenflora d. Mark Brandenburg, iii. heft 1 (1907) pp. 1–128 (figs.).
† Beih. Bot. Centralbl., xxi., 2te Abt. (1907) pp. 103–219 (7 pls., 89 figs. in text).
‡ Bull. Herb. Boiss., vii. (1907) pp. 225–36.

the plankton of the Schœnenbodensee. He gives a table of the relative abundance or absence of the species month by month, and analyses the results. In another table he shows the presence or absence of 103 of the commoner algæ in Schœnenbodensee and four other small Swiss lakes. Schœnenbodensee is relatively rich in Chlorophyceæ, Desmidiaceæ, and Diatomaceæ, and poor in Schizophyta, Peridineæ, and Flagellatæ. Therein it differs from the small lakes of the Swiss plateau. In fact the more elevated the lake, the less do its characters depend on its depth, and the more is the composition of its microflora influenced by variations in its temperature.

Plankton Studies in Salzkammergut.*—K. von Keissler gives lists of the phytoplankton collected in seven lakes in Salzkammergut, at a height not exceeding 1000 m. above sea-level. Several rare species were found. A comparison of the respective floras shows that neighbouring lakes, when examined at the same time of year, may exhibit a totally different plankton. Again, some of the lakes had much and some but little plankton, and in cases where two neighbouring lakes showed plentiful material, the composition of each was different. Among the records is a species of *Melosira*, a genus which has till now only been recorded from a few Austrian alpine lakes.

Marine Plankton.†—A. Nathansohn writes an important paper on the influence of vertical movements of the water on the production of marine plankton. He criticises the work of Brandt and his explanation of the fact that the amount of plankton is much greater on the edge of cold regions than in warm currents. Brandt considers that this is connected with the compounds of nitrogen, which, according to his theory, are found more plentifully in colder than in warmer waters, because denitrifying bacteria break up the nitrates and nitrites present more easily in warmer water. Nathansohn holds that Brandt's theory does not account for all the facts, and that though denitrifying bacteria are certainly widely distributed in the sea, their power of separating free nitrogen from nitrates is merely a facultative one, since in the open sea neither nitrites nor nitrates are formed from nitrifying bacteria. On the other hand, he regards as a very important factor the vertical currents in the sea, which arise from many causes. A large number of dead organisms sink from the top to the bottom layers of water, thereby removing a considerable quantity of important nutritive material from the upper layers, and this has to be returned by upward currents to the surface. In shallow waters this depletion cannot take place, which explains the relative richness of these regions. An investigation and comparison of various regions has allowed the author to deduce the following general rule, namely, that the regions rich in plankton in the far north and south, and, to a certain extent, the tropical seas, are distinguished by currents ascending vertically upwards; whereas in the temperate regions, poor in plankton, there are either no vertical currents, or they are descending ones. In the last chapter the various nutritive matters are described, of which

* Oesterr. Bot. Zeitschr., lvii. (1907) pp. 51–8.
† Abh. Math.-Phys. k. Sächs. Ges. Wiss., xix. (1906) No. 5; Bot. Zeit., lxiv. (1906) pp. 345–8.

the distribution is specially influenced by vertical currents. Further details on these questions are promised.

Diatoms of Germany.*—H. von Schönfeldt publishes a complete work on the Diatoms of Germany, both fresh-water and marine. His book is divided into two sections, a general and a special part. In the former the author deals with the habitat, manner of collecting, treatment of material at home, preparation for the Microscope, and the drawing of specimens. He then goes on to speak of the structure and life-history of Diatoms, under the headings of Structure of the diatom-cell; cell-wall; raphe; symmetry of the frustules; cell-contents, including protoplasm; nucleus; centrosome, chromosomes, etc.; gelatinous sheath, including pores, colonies, stem-formation, etc.; movements of diatoms; reproduction by cell-formation and auxospores; exit of new individuals from the perizonium; the various forms of spores produced and tenacity of life. Fixing media and reagents are also dealt with here. The special part of the book opens with keys to the families, genera, and sub-genera, and then goes on to a description of each species, giving also references to literature and plates previously published. Then follow a complete list of the important literature on the subject, and indices to each part of the present work. The book is illustrated by more than 400 figures on 19 plates.

FOSLIE, M., & M. A. HOWE—**Two New Coralline Algæ from Culebra, Porto Rico.**
[The algæ in question are *Goniolithon acropetum* and *Lithophyllum antillarum*, the latter being a reef-builder.]
Bull. Torrey Bot. Club, xxxiii. (1906) pp. 577–80 (2 pls.).

KAWAKAMI, T.—**List of Plants collected in Agincourt Island, Formosa.**
[Contains 23 algæ, one of which is a new *Codium*, without description. Japanese text.]
Tokyo Bot. Mag., xx. (1906) pp. 199, 200.

MANGIN, A.—**Distribution des algues: algues fixées, algues du plankton.** (Distribution of algæ: fixed species and plankton.)
Bull. Mus. Océanogr. (Monaco, 1906) 33 pp.

PALIBINE, J.—**La microflore de la mer de Barents et de ses glaces.** (The microflora of the Barents Sea and of its ice.)
[An account of modern knowledge concerning marine phytoplankton in general, and researches in the Arctic regions in particular.]
Bull. Jard. Imp. Bot. St. Pétersbourg, vi. (1906) pp. 159–83.

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

Two Species of Peronospora.†—Alberto Noelli has examined the forms of *Peronospora* that occur on *Chenopodium*, *Spinacia*, *Atriplex*, *Polygonum*, etc. It had been held by Laubert that the form that grew on spinach was a different species, and that the proximity of diseased plants of the other genera was not a source of danger. Noelli found *Chenopodium* and spinach growing together, and both attacked by *Peronospora*. He examined the fungus and found such slight morphological differences that one might be a variety of the other. *P. Spinaciæ* is evidently the same as *P. effusa*.

* Diatomaceæ Germaniæ. Berlin: W. Junk, 1907, 263 pp., 19 pls., 456 figs.
† Malpighia, xx. (1906) pp. 406–8.

Phytophthora and Plasmopora in Ohio.*—*Phytophthora infestans*, the deadly potato disease, is rare in Ohio. A. D. Selby has examined into the climatic conditions that have determined its appearance in Ohio and elsewhere. He suggests that, as the potato is a native of cool regions, it is evident that the parasite will also be favoured by the same weather conditions as the host. A succession of cool seasons in Ohio would give opportunity to the fungus to spread into the country, and a cycle of hot or dry seasons would again stamp it out.

Plasmopora cubensis is a sub-tropical species first recorded from Cuba. It has done much damage to garden cucumbers and squashes. It makes its appearance in Ohio earlier in a warm season than a cold one. It survives the winter in Florida, and each season it seems to advance northward with the warmer weather.

Zygospores of Rhizopus nigricans.†—Boleslas Namyslowski found that two plants were included under *R. nigricans*, the one originally described by Ehrenberg as *R. nigricans*, the other, cultivated at Utrecht, which he names *R. nodosus*. It was found that the latter produced only sporangia in all circumstances, while from the former in suitable conditions zygospores could also be produced. The structure and development of the zygospores has been followed and described. They contain a large number of nuclei of varying size, but no copulation was observed, and the role of these nuclei has not been determined. The author contests A. Blakeslee's theory as to the heterœcious nature of this fungus. He grew plants from one spore and obtained from the culture a plentiful growth of zygospores. The condition necessary to induce the formation of zygospores is a suitable medium, which was found in bread soaked in grape-sugar, or in slices of pear. He never obtained the spores on bouillon, peptonised water, potatoes, gelatin, bouillon-jelly or beer-must. In addition, the air must be saturated with humidity, but not too moist. When it is supersaturated all development ceases. If the air is dry, sporangia only are produced. Namyslowski is of opinion that Blakeslee, in the case of this fungus, had sometimes a mixture in the culture, and where no zygospores were produced, the reason was to be sought in the culture medium rather than in the nature of the plant.

Morphology of the Ascocarp, and Spore-formation in the Many-spored Asci of Thecotheus Pelletieri.‡—This minute fungus, a member of the Ascoboleæ, has been investigated by James Bertram Overton. He gives a résumé of all the literature bearing on the different points touched on by him in his examination of the fungus, and then recounts results of his own observations, which he sums up thus: (1) The fruit-body of *Thecotheus* is formed from several ascogonia, and is, therefore, a compound apothecium. The ascogonia are multinucleate, some containing as many as a dozen nuclei. (2) The ascogenous hyphæ arise from any or all of the cells of the ascogonium, and, consequently, the cells of the ascogonium are not connected by

* Ohio Naturalist, vii. (1907) pp. 79–85.
† Bull. Acad. Sci. Cracovie, Classe Sci. Math.-Nat., 1906, pp. 676–92 (1 pl. and 12 figs.).
‡ Bot. Gazette, xlii. (1906) pp. 450–92 (2 pls.).

perforations through which the nuclei pass to enter the ascogenous hyphæ. (3) The ascogenous hyphæ do not in this case constitute a synkaryophytic system. (4) The asci arise from the subterminal cells of the recurved tips of the ascogenous hyphæ, which cells are binucleate; these hyphæ are profusely branched, and develop considerably before becoming septate. (5) The ascus nucleus is formed by the fusion of the two primary ascus nuclei; it enlarges as the ascus grows. (6) It then divides by triple division to form eight free nuclei, each of which, after a period of rest and growth, undergoes further division, until thirty-two free nuclei are formed in the ascus. (7) Spore delimitation follows, the astral rays bending over and fusing to form a spore membrane. (8) Each spore is one-celled and uninucleate. (9) The endospore becomes more granular and hyaline as the spore develops, and the outermost portion of the hyaline granular area constitutes the exospore. (10) No evidence has been found to support the theory that the ascus is homologous with the sporangia of either the Oomycetes or the Phycomycetes. (11) The formation of the large number of spores is evidently an adaptive phenomenon, and does not interfere with the conception that the ascus is a spore-mother-cell. Overton traces an alternation of generations in this as in other Ascomycetes—the sporophyte including the ascogenous hyphæ and the asci up to the time of the reduction division (one of the divisions in the ascus), which initiates the gametophyte generation. He adds that ascospores which are septate have apparently begun an intrasporal germination, the gametophyte forming considerable embryonic tissue within the old spore-wall.

Witches' Brooms.*—James Saunders has recorded his observations on these deformations on trees in the tract of country that lies around Luton. The brooms, though usually due to *Exoascus*, a parasitic fungus, may also arise from the irritation caused by insects, or by "gnarling," i.e. an excessive development of leaf-buds on the branches or main stems. The writer confines his attention to those brooms that are caused by fungi. He describes the particular cases that he has noticed, and the appearance of the abnormal growth. On cherry and wild cherry the effect is the same: the leaves on the diseased branches are red and crumpled. Three cases on hawthorn are described: the branching of the brooms was different from the rest of the tree, and many of the twigs were strangely distorted. A broom was also found on an elder-tree. Others grew on the elm, probably caused largely by gnarling. Birch-trees, hornbeams, and hazels were found with similar growths due to the fungus. Brooms were also found causing deformations on spruce-fir and silver-fir. They were caused by forms of Uredineæ.

A series of observations was made as to the unfolding and fading of leaves on the brooms, and it was found that though, in some cases, the leaves came earlier than on the normal branches, they always faded earlier. An acceleration of development accompanied by diminished vitality is generally characteristic of all these abnormal growths.

Hypocreaceæ and Scolecosporeæ from Java.†—M. Raciborski remarks that he found no form of *Claviceps* on grasses in Java, but that

* Trans. Herts. Nat. Hist. Soc., xiii. (1907) pp. 67–78 (3 pls. and 1 fig.).
† Bull. Acad. Sci. Cracovie, Classe Sci. Math.-Nat., x. (1906) pp. 901–11 (2 pls.).

the closely allied family of Hypocreaceæ was well represented. He describes three species of *Epichloë*, one of them new. A large *Balansia gigas* sp. n. was specially noteworthy; it forms in the flower of *Paspalum* sp., the yellowish brown stroma, 1–2 cm. broad and high, becoming studded all over with the stalked fruits. Species of *Hypocrella* and *Barya* are also described and *Ophionectria anomala*, a new species.

Notes on Ergot.*—The sclerotia of a *Claviceps* found on *Sesleria cærulea* were forwarded to Rob. Stäger, who used them to make an exhaustive series of culture experiments on a large number of grasses, with negative results, except in the case of *Melica nutans* and *M. uniflora*. He concludes that he is dealing with a biological form of *Claviceps purpurea*, or, more probably, with a new species which he names *C. Sesleriæ*. He gives a diagnosis of the species, and compares the conidia with those of other species. They are much larger, and the appearance of the sclerotium in tranverse section is also different.

Spread of the Gooseberry Disease.†—Wilhelm Herter traces the distribution and rapid increase of this disease, due to the fungus *Sphærotheca mors-uvæ*, since its appearance in Europe in 1900. Like other new parasites, it has spread with alarming rapidity, and since the above date it has been recorded in Ireland, Russia, Sweden, Denmark, Germany, Finland, Norway, and Hungary. It is doing enormous damage, and unfortunately the usual spraying with fungicides is of little avail. Rooting out and burning the diseased bushes has been everywhere recommended. In Finland and Sweden the governments are aiding by forbidding fresh importations of bushes or of fruits, and by paying the cost of destroying the attacked plants. Should the present race of bushes be hopelessly ruined, Herter thinks we must resort to new breeds which are found to be more immune than those now in cultivation.

Form of Colonies of the Lower Fungi.‡—H. B. Hutchison has made comparative studies of the form of growth of a number of bacteria, and also of two forms of *Saccharomyces*. His object was to test their sensitiveness to light, temperature, etc. He finds that the lower organisms are very sensitive to light, especially in the presence of oxygen. He describes the colonies, grown in darkness, of distillery yeast and Frohberg yeast, and notes differences in the cells according to the position in the colony. He also studied growths of *Oidium lactis* and *Mycoderma*, both the form and structure of the colonies.

Atlas of the Saccharomycetes.§—Many papers on *Saccharomyces* have been published in recent years in different journals, and the knowledge and literature of the subject have increased very largely, both in the detection of new forms and in the better understanding of those yeasts in daily use for brewing, etc.; but this knowledge has been largely inaccessible to the ordinary student. Alfred C. Chapman and F. G. S. Baker have therefore rendered a very great service to science in

* Centralbl. Bakt., 2te Abt., xvii. (1907) pp. 773–84.
† Tom. cit., pp. 764–78 (2 figs.).
‡ Tom. cit., pp. 417–27 and 593–604 (4 pls. and 7 figs.).
§ Brewery Trade Review, 13 Little Trinity Lane, E.C., 1906 (17 pls. and 102 figs.)

publishing their atlas of 17 plates, each containing six micro-photographs of yeasts, and representing 32 different species. The plates appeared originally in the "Brewing Trade Review," and have now been issued in atlas form, each plate being accompanied by a short explanatory note. The authors restrict the term Saccharomycetes to those budding fungi which are capable of reproducing by the formation of ascospores. Some of these are much cultivated for industrial use, others more or less associated with them are "technologically pathogenetic," and are capable of communicating to the products of their fermentative activity flavours and odours, or other undesirable characters.

The industrial culture yeasts are treated first in order, and the different plates show various growths and developments—sedimentary forms, budding forms, young films, formation of ascospores, etc. The magnification is the same in most cases, so that comparison is rendered simple and easy. Incidentally explanations are given of such terms as "Saaz," "Frohberg," and "Logos," which refer to the breweries where the yeasts have originated. On the fifth and succeeding plates photographs are reproduced of wild yeasts and some other forms. These yeasts occur in nature, some of them growing on the outside of various fruits, and give certain desirable qualities (or the reverse) to wine, beer, etc. A few have been isolated from the air of the brewing houses, among these being *S. pastorianus I.*, a virulent "disease" yeast which imparts an intense and nauseous bitter flavour to beer. Other yeasts are represented which have been found in certain slimy secretions of oak trees, and on the damaged roots of an elm tree. Finally, three photographs are given of *Zygo-saccharomyces*, discovered by Barker on commercial ginger. The unusual phenomenon of conjugation is found to occur in this fungus; the cells put out small protuberances, and where two of these happen to be in proximity to each other, they unite, becoming connected by a narrow canal. The photographs are remarkably clear, and show the characteristics of the various species under different conditions of culture.

American Fungi.*—Two parts of the "North American Flora," dealing with the fungi of the country, have just been issued. J. C. Arthur edits the Uredinales, which have been arranged according to his own conception of systematic order in that group, with all the new genera proposed by himself. G. P. Clinton has taken charge of Ustilaginales, comprising Ustilaginaceæ, with eleven genera represented in the States, and Tilletiaceæ, with seven genera. Clinton's part is complete, and is provided with a good host-index.

Uredineæ.†—E. Fischer reviews the recent literature bearing on heterœcy and specialisation in the Uredineæ. He notes the increasing number of forms that have been proved to be heterœcious. Much of the work in the field has been done by J. C. Arthur in North America, while Tranzschel, W. Müller, W. Kreig, and Semadeni, have conducted experiments with varying results in the Old World. The existence of specialisation in this group has also been proved. Lately P. Cruchet

* North American Flora, vii. (1907) part 1 (Ustilaginales) 82 pp.; part 2 (Uredinales) 160 pp.

† Bot. Zeit., lxv. (1907) pp. 49–54.

has found biological forms in the *Pucciniæ* of the Labiatæ. Other forms have been found to infest a large series of plants, such as *Puccinia Isiacæ*, the teleutospores of which are to be found on *Phragmites communis*, as also on plants of Cruciferæ, Capparidaceæ, Caryophyllaceæ, Chenopodiaceæ, Umbelliferæ, Valerianaceæ, Borraginaceæ, Labiatæ, and Scrophulariaceæ.

Fischer * also criticises Arthur's new classification of Uredineæ, and his invention of a new terminology. Arthur has laid great stress on the position of the spore-layer in the tissue of the host—whether in the superficial tissue or deeper in the mesophyll. He has also grouped the genera in tribes, according to the number of spore-forms developed in each plant. Fischer questions the value of his deductions; as, for instance, when he makes the presence or absence of the *Æcidium* a leading character in determining the place of the plant in his system. It has been proved that the presence of *Æcidia* is largely a matter of climate. He finds, also, that the position in the tissue of the host-plant is a specific distinction, and not so important as Arthur would have it. Further, he disapproves of Arthur's substitution of new terms for old, finding them unnecessary.

Paul Cruchet † continues his examination of the *Pucciniæ* that infest Labiatæ. He finds a new species with its *Æcidium* on *Prunella*, the *Puccinia* form of which grows on *Molinia cærulea*, which he calls *P. Brunellarum-Moliniæ*. Two other species are given as growing on *Molinia*, viz. *P. nemoralis* and *P. Moliniæ*, but he has decided that the new species has nothing to do with these forms. He experimented also with *P. Stipæ*, with *Thymus vulgaris*, as a new host for the *Æcidium*, with *P. Glechomatis*, *P. annularis*, and *P. Stachydis*, the latter belonging to the group of Brachypucciniæ, with two possible hosts, *Stachys recta* and *S. annua*. The paper is illustrated by a plate and figures of the teleutospores, and by tables showing the different experiments.

Frank D. Kern ‡ supplies notes on the methods employed in experimenting on Uredineæ. All grass and sedge-rusts are heterœcious, and teleutospores from these plants afford good culture material. He gives advice as to the date of collecting the spore material, the method of preserving it during the winter, and the best time for infection experiments. If æcidiospores are to be used, the leaves bearing the *Æcidia* are suspended over the host so that the spores may fall on the leaf. In all cases, the host-plant should first be moistened by spraying. In the case of teleutospores and uredospores, they are directly cut from the sorus and applied to the leaf. The author directs how care should be taken to prevent other infections than the one intended, and to secure the most favourable conditions for the development of the fungus.

Guy West Wilson § has made a study of the rusts that occur in some of the Indiana counties. He signalises twelve of the species as injurious, as they infest cultivated plants. Among these are the grain-rusts *Dicæoma poculiforme* and *D. Rhamni*, the blackberry rust *Gymnoconia interstitialis*, with other rusts of clover, corn, asparagus, etc.

* Bot. Zeit., lxv. (1907) pp. 54–9.
† Centralbl. Bakt., xvii. (1906) pp. 497–505 and 674–84 (1 pl. and 5 figs.).
‡ Indiana Acad. Sci., 1905, pp. 127–31. § Tom. cit., pp. 177–82.

After a series of experiments, Fr. Bubak * has proved that *Æcidium Plantaginis* belongs to the life-cycle of *Puccinia Cynodontis*, that *P. Sesleriæ* does not form *Æcidia* on *Rhamnus saxatilis*, *R. cathartica*, or *R. Frangula*, and that *P. Anthoxanthi* is not connected with the *Æcidium* on *Ranunculus bulbosus*. Bubak has also been able to confirm Fischer's statement that *P. Willemeteæ* belongs to the Auteupuccinieæ; he grew all three spore-forms on the same plant.

Ernst Jacky † records observations and experiments in connection with ten different species of *Puccinia*. He gives also notes as to the wintering of uredospores. He has proved in several cases additional to those already known, that these spores do last through the winter and reinfect the host-plants in spring. He has overthrown the idea that the teleutospores of *Phragmidium subcorticium* do not germinate, as he obtained an abundant growth of promycelium and basidiospores. He has made other experiments with *Phragmidium* spores, and has established the connection of *Uredo Mülleri* and *Pragmidium albidum*, and has proved that this fungus will not grow on *Rubus Idæus*.

Polyporus fulvus.‡—Josef Schorstein has found this fungus growing as a saprophyte on dead willow-trees; the mycelium penetrates to the pith, which it hollows out. The author has made drawings of the hyphæ, and recommends that the hyphæ of such wood-infesting fungi should always be illustrated, as they are often very characteristic.

Observations on Pileate Fungi.§—J. E. Lange has studied the geographical distribution of the larger fleshy fungi. He divides them into two series. (1) Wood flora, including forms that grow on wood itself, and forms that grow among the trees. (2) The flora of the open country—on field, moor and heath, etc. He also gives notes on the time and duration of growth. He finds that such a study is difficult because fungi do not spring up every year in the same locality. He considers that the spores are of minor importance in the distribution of the species, and that the mycelium lives over the year and gives rise to the new crop of plants.

Fungi New to Yorkshire.||—C. Crossland publishes a considerable list of fungi which have been added to the county flora since the Yorkshire Fungus Flora was published. Two of them are new to science, *Clavaria gigaspora* and *Verticicladium Cheesmanii*. Seven are new to Britain and the others new to Yorkshire. A coloured plate is given of the new *Verticicladium*, a distinct and well marked form that grows on decorticated wood.

Fungi from St. Louis.¶—N. M. Glatfeltes publishes a preliminary list numbering about 500, mostly of the larger fungi, collected in the neighbourhood of St. Louis from 1898 to 1905. He mentions several curious facts in connection with the growth of these plants. Some are

* Centralbl. Bakt., xviii. (1907) pp. 74–8. † Tom. cit., pp. 74–93.
‡ Zeitschr. Land. Versuch. Oesterr. (1906) 3 pp. (1 fig.). See also Hedwigia, xlvi. (1907) Beibl., p. 60.
§ Bot. Tisskr., xxvii. (1906) heft 2, pp. 57–44. See also Bot. Centralbl., civ. (1907) pp. 370–1. || Naturalist, 1907, pp. 97–105.
¶ Trans. Acad. Sci. St. Louis, 1906, pp. 33–94.

rare, having been found only a few times. No specimens of such common forms as *Marasmius oreades*, *Russula emetica*, or *Amanita muscaria* were found. *Cortiniarius* was rare until 1905. Careful spore measurements are given, all of them taken by the author. The date and locality of each collection are also given. A number of Mycetozoa are included in the list.

Fungi in Denmark.*—F. Kölpin Ravn made a series of observations of plant diseases on the islands in the Cattegat. They corresponded usually with those of the neighbouring mainland. *Puccinia graminis* was frequently met with, although *Berberis* did not grow on the island. Another species, *P. cerenifera*, was observed, its æcidial host *Rhamnus cathartica* also being absent.

L. K. Rosenvinge † describes a marine fungus parasitic on *Chondrus crispus* which he names *Leptosphæria Chondri*. The cystocarps and tetrasporangial sori alone were attacked. He also notes the occurrence of some subterranean fungi and of *Geaster triplex*; these are all recorded from Denmark or North Cattegat coasts.

Classification of Fungi.‡—P. A. Saccardo and G. B. Traverso give an outline of the scheme of arrangement adopted for this group of Cryptogams in the Flora Italica Cryptogama. They do not claim finality for their scheme, as the knowledge of many of the groups and forms is still very imperfect. They have aimed at a system that represents present day scientific attainments, and that is also simple and practical. They recognise three great divisions: Eumycetæ, including Teleomycetæ and Deuteromycetæ; Myxomycetæ; and Schizomycetæ. Each subdivision contains Classes: Basidiomycetæ, Ascomycetæ, etc., and, below these, the Orders ending in 'ales,' such as Hymeniales, Gasterales, etc., which are again divided into families, Agaricaceæ, Polyporaceæ, etc.

Some Elements of Plant Pathology.§—U. A. Cobb has issued under the above title a pamphlet of instructions on plant diseases to planters, especially of sugar-cane. He informs them of the nature and structure of both hosts and fungal parasites. He explains the reasons why prolonged cultivation of plants without any pause makes them peculiarly liable to attack, and he describes the way in which the fungus gains entrance to and destroys the tissues of the host. Advice is given as to the usé of fungicides and the selection of disease-proof varieties.

Self-heating of Hay.‖—It has long been known or surmised that the self-heating of hay was due to bacteriological action. Hugo Miehe has published a treatise on the subject, giving an account of the various experiments whereby he has proved that the heating is due to physiological action alone. He has also isolated and cultivated the micro-

* Tids. Landbr. Planteavl., xiii. (1906) pp. 116–24. See also Bot. Centralbl., civ. (1907) pp. 257–8.

† Bot. Tidssk., xxvii. heft 2 (1906) pp. 33–6. See also Bot. Centralbl., civ. (1907) pp. 258.

‡ Bull. Soc. Bot. Ital., 1907, pp. 22–8.

§ Rep. Exp. Stat. Hawaiian Planters' Assoc. Honolulu, 1906, 46 pp. (2 figs.).

‖ Die Selbsterhitzung des Heus. Jena: Gustave Fischer (1907) 127 pp. (11 figs.)

organisms that directly or indirectly take part in the heating process. The three most prominent organisms are a form of *Bacillus coli*, *Oidium lactis* and *Bacillus calfactor*, sp. n. He gives accounts of each and of their behaviour in different cultures. Miehe also isolated a number of fungi and bacteria that find their natural habitat in the overheated mass of hay. *Actinomyces thermophilus* formed white streaks and spots on heated grass that was still full of sap. *Thermomyces lanuginosus* was gathered when the temperature was at the highest point; *Thermoascus aurantiacus*, g. et sp. n. occurred in tiny yellow spots. It is one of the lower Ascomycetes near to *Gymnoascus*. *Aspergillus fumigatus* was frequently met with; it is not necessarily a thermophil fungus, but it grows best at blood heat. *Mucor pusillus* was very common on the warm hay. The zygospore of this species was found for the first time by Miehe. *Mucor corymbifer* was also isolated and cultivated. These fungi are more or less pathogenic, and it is a new discovery that their natural habitat should be heated plant remains. The author thinks that other inimical fungi and bacteria probably owe their propagation to the hot beds of manure, and that the prevalence of the tubercle bacillus may be due to the many natural culture-beds.

Some of the experiments were directed to gauging the rise and the amount of temperature in a mass of heated hay. On the second day the mass began to sweat; by the sixth day the highest point, 68·5° C., was reached in the centre of the rick. It was found that at a certain stage self-sterilisation occurred; the organisms all died off. The reason for this was, however, not satisfactorily demonstrated.

Other chapters are devoted to the heating of tobacco leaves, which plays a large part in the ripening process. The questions of heat and respiration are discussed. The author fancies that such self-heating must have occurred in the early days of the earth's history in the gigantic masses of piled-up plant remains, and that this must have been an important factor in the formation of coal.

J. Adams * draws attention to the same subject, pointing out the high temperatures at which fungi can grow. He tested the heated ricks, and found that the thermometer rose to 57½° C. (equal to 135½° F.). The hottest parts of the rick were completely infested with a fungus bearing sporangia, a species of *Mucor* in all stages of development. He noted still another fungus, with brown septate mycelium but without fructification.

Plant Diseases.—Von Tubeuf † writes on the very wide dispersion of the fungus *Trametes Pini*. It occurs over the whole of Germany up to Alpine regions. It attacks not only the native Conifers but also foreign species that have been introduced. Traces of its ravages have been identified in fossil wood.

P. Magnus ‡ has described a disease of mushrooms due to *Mycogone perniciosa*. It produces chlamydospores and *Verticillium* conidia and

* Irish Naturalist, xv. (1906) pp. 254.

† Nat. Zeitschr. Land. Forst., 1906, heft 2. See also Centralbl. Bakt., xvii. (1907) pp. 812–13.

‡ Natur. Rundschau, xxi. (1906) 3 pp. See also Bot. Centralbl. civ. (1907) p. 337.

is, he believes, a form of *Hypomyces* that never attains the full development. The parasite burrows between the cells of the host, and is most luxuriant in the stalk.

J. M. Van Hook * finds that two fungi are responsible for much damage to garden peas—*Ascochyta Pisi* and *Erysiphe communis*. For the latter, fungicides are of value in killing the mycelium which is superficial. As regards the former it is advisable to choose varieties of peas that are able to resist the disease. Even the seeds become infected, the fungus attacking the pods and growing through the seed-coats.

Experiments † have been made with the spores of *Macrosporium Solani*, which have proved it to be identical with *M. tomato*. This fungus causes leaf-curl, and can be perpetuated by hybernating mycelium in the tuber.

Fungus of Lolium temulentum.‡—E. Hannig has made a thorough study of this plant and its mysterious fungus. He finds that, though it is rare to gather seeds that are not infected, yet occasionally there are whole plants that are free, and also occasionally some seeds are healthy though borne on diseased plants. It was found impossible to distinguish the two kinds of plants or seeds by their outward form: they had to be examined microscopically. Fortunately the examination did not kill the seeds; they grew into healthy plants even though the larger part of their endosperm had been cut away. The author has also examined the nature of the poison contained in the fungus, and finds that when it is present the seeds contain an alkaloid.

Structure of a Fungus-gall.§—A. Trotter describes the anatomy of a gall produced on *Grevia venusta* by *Ustilago Greviæ*. He finds two different tissues: the interior is sclerotic, the outer layers parenchymatous and covered by a thin corky layer. Between the two tissues the gall is traversed by vascular elements connected with the vascular system of the host-plant. The gall begins to grow on the very young branch, and the development is centrifugal round the centre of infection.

Connection of Fungus Mycelium with the Substratum.‖—C. Kratz has examined the relations between fungus and substratum in some saprophytic Pyrenomycetes. He worked with forms that live on herbaceous stems such as nettles, and on dead leaves. The structure of the plant tissue influences the growth of the mycelium, which cannot penetrate hard fibre, and finds its way into the woody tissue by the medullary rays. The position and growth of these fungi on nettles point to the likelihood of their being parasites at an early stage of their development.

Diseases of Plants.—A report from Linhart ¶ is to hand on the result of spraying melons and cucumbers with Bordeaux mixture in order to combat the disease caused by the fungus *Pseudoperonospora cubensis*.

* Ohio Agric. Exper. Stat. Bull., clxxiii. (1906) pp. 231-49. See also Bot. Centralbl., civ. (1907) pp. 337.

† Kew Bull., 1906, pp. 242-5.

‡ Bot. Zeit., lxv. (1907) pp. 25-37.

§ Malphigia, xix. (1905) pp. 456-65 (4 figs.). See also Bot. Centralbl., civ. (1907) p. 212.

‖ Berliner Diss. (Dresden, 1906) 28 pp., 8 figs. See also Bot. Centralbl., civ. (1907) pp. 367-9.

¶ Zeitschr. Pflanzenkr., xvi. (1907) pp. 321-2.

He applied the practical test of spraying one row of plants and leaving another alone, with the result that the unsprayed plants all rotted from the attack of the fungus. During a very cold and very wet summer, he found that the normal amount of spraying was insufficient as the solution was washed off by the heavy rains and the fungus got the upper hand. In such a season he recommends extra spraying and with a stronger solution than that usually employed.

G. Lustner * publishes an account of work done at the plant pathological research station at Gesenheim. An unusually virulent attack of the vines by *Peronospora* occurred. The infection of the berries spread evidently from the stalk. He discusses at length a disease of cherry-trees and alders on which species of *Valsa* were found. He concludes that the trouble was due to soil conditions, and the fungi were saprophytes.

R. Solla † gives a résumé of reports sent as to Italian plant diseases. A. Noelli contributes a list of 200 fungi from the neighbourhood of Turin, many of them parasites and hurtful to the higher plants. G. B. Traverso records those occurring on the trees and herbs in the Como district, on oak, chestnut, almond, etc.

E. Barsali ‡ found *Polyporus Schweinitzii* at the base of a pine-tree near Pisa. He reports also various Uredineæ on cereals, beans, onions, etc.

Amed. Berlese § found a fungus growing on the shield-louse, *Ceroplastes Rusci*. He isolated it and grew it on various media. He determined and named the fungus *Oospora Saccardiana*.

Reproduction and Regeneration in Fungi.‖—Paul Köhler reviews the work done on this subject by various authors, proving that isolated parts of a fungus plant could grow and produce fruits in various species. He then proceeds to give the result of his own researches. In *Mucor stolonifer* he found that if a portion of the mycelium were wounded, the damaged part was cut off by a cell-wall. If the hypha were divided each part continued to live and grow, reproducing the whole plant. Sporangiophores and sporangia also continued to develop when they had reached an advanced stage and the columella was formed. At an earlier stage they failed to grow when cut off and placed in the culture solution. Stolons and rhizoids were unable to grow when separated from the plant. *Phycomyces nitens* was found to be more capable of regeneration than *Mucor*; the wounded parts proliferated instead of being cut off by a cell-wall.

With *Penicillium glaucum* and *Aspergillus niger* it was found that any cell was capable of growing and reproducing the plant.

Experiments were also undertaken with the higher fungi—*Agaricus campestris*, *Coprinus stercorarius*, etc. It was found that in many of the Agaricineæ and in *Coprinus* all living cells are capable of growth, and that cells of the cap, stalk, hymenium, and surface possess the capacity of regeneration and reproduction. Among the Polyporeæ it was found that for further growth the fungus must remain on its substratum, and in *Xylaria hypoxylon* only the cells near the growing

* Zeitschr. Pflanzenkr., xvi. (1907) pp. 323–7.
† Tom. cit., pp. 328–9. ‡ Bull. Soc Bot. Ital., 1906, pp. 93–8.
§ Zeitschr. Pflanzenkr., xvi. (1906) p. 329.
‖ Flora, xcvii. (1907) pp. 216–62 (10 figs.).

points could reproduce the fruiting body, though any part of *Xylaria arbuscula* was found to be capable of doing so.

In a series of experiments on the continuance of the cells of *Aspergillus niger*, Köhler found that in nutritive solutions the cells lasted four to five days, and that this time was in no way influenced by spore production. He found also that cells on the surface of the culture had a longer life, and concluded that external factors, such as want of oxygen and accumulation of harmful growth-products, contributed to the death of the cells.

Fungi used in the Preparation of Batata Brandy.*—This form of spirit is prepared in Japan, and K. Saito found that several filamentous fungi entered into its preparation, along with a new yeast, *Saccharomyces Batatæ*. The most important factor in the fermentation process was *Aspergillus Batatæ* sp. n., nearly allied to *A. niger*, but differing in the size of the conidia and in the colour of the growing tufts. Two other species were isolated and determined, *A. pseudoflavus* sp. n., and *Rhizopus chinensis*. Full descriptions of the new fungi are given, and they are well illustrated.

Handbook of Technical Mycology.†—Under the editorship of Franz Lafar a number of parts of this great work have been issued. Fascicle 13 of vol. iii. includes the mycology of water, by H. Wichman, A. Reinsch, and R. Kolkwitz; and the mycology of dung, by J. Behren. In other fascicles A. Klocker deals with the Saccharomycetes, their variability and classification; and C. Wehmer writes on the Aspergillaceæ, a family in which there is still much confusion owing to the want of knowledge of development of the different forms. G. Lindau deals with the conidial forms of *Cladosporium herbarum* and *Dematium pullulans*, and H. Wall with the Torulaceæ. The mycology of brewing, etc,, is treated by Lindner, Wichman, Wehmer, and others.

Cryptogamic Botany.‡—J. P. Lotsy has just published a series of lectures to students on the above subject, which are mainly concerned with Algæ and Fungi. In his treatment of the Fungi he lays stress on the passing over from water to land life. He describes the morphology and cytology of the various groups and genera, beginning with the Monolpidiaceæ and going through all the water forms first. The Schizophytæ are next dealt with, then the Myxobacteria, the Myxomycetes, and, finally, the Eumycetes, which include the two great groups of Ascomycetes and Basidiomycetes. The lichens are taken up under the Ascomycetes. There is a copious bibliography, and a good index to the volume.

ANON.—**Fungi Exotici V.** *Kew Bulletin*, 1906) pp. 255–58.

BENECKE, W.—**Kleine Mitheilungen über oxalsäurebildung in Pflanzen.** (Short contributions on the formation of oxalic acid in plants.)
[Benecke criticises Wehmer's work on this subject, and adds notes on the growth of *Aspergillus niger* in various culture solutions.]
Bot. Zeit., lxv. (1907) pp. 73–81.

BUBAK, FR., & KABAT, J. E.—**Mykologische Beiträge.** (Mycological contributions.) *Hedwigia*, xlvi. (1907) p. 288.

* Centralbl. Bakt., xviii. (1907) pp. 30–7 (2 pls.)
† Jena: G. Fischer. See also Bot. Zeit., lxv. (1907) pp. 61–2.
‡ Jena: G. Fischer (1907) 828 pp. 430 figs.

CUFINO, LUIGI—**Note Micologiche Italiane.** (Italian mycological notes.)
[A list of fungi from the neighbourhood of Naples.]
Malpighia, xx. (1906) pp. 345–52.

JAAP, O.—**Fungi selecti exsiccati.**
[The specimens all belong to the microfungi, and include a number of rare forms.] Hamburg, 1906, series viii. No. 176–200.
See also *Bot. Centralbl.*, civ. (1907) p. 368.

KOHN, E., & CZAPEK, F.—**Beobachtungen über Bildung von Säure und Alkali in künstlichen Nährsubstraten von Schimmelpilzen.** (Observations on the formation of acids and alkalis in artificial cultures of filamentous fungi.)
[Records observations with *Aspergillus niger* and *Penicillium*.]
Hofmeister's Beit. Chem. Phys. Path., 1906, pp. 302–12.
See also *Bot. Zeit.*, lxv. (1907) pp. 83–6.

KRIEGER—**Fungi saxonici exsiccati.**
[A number of new forms are included.]
A. E. Konigstein (1906) Nos. 1951–2000.
See also *Bot. Centralbl.*, civ. (1907) pp. 369–70.

MASSALONGO, C.—**Nuove reclute della Flora Micologica del Veronese.** (Additions to the mycological flora of Verona.)
[Eighty-two fungi are listed, of which three are new to science.]
Malpighia, xx. (1906) pp. 159–70.
See also *Bot. Centralbl.*, civ. (1907) pp. 211–12.

MASSEE, G.—**A Text-book of Plant Diseases.**
[A third edition of this book. It contains eight new pages, dealing with potato, gooseberry, and pine diseases.]
London: Duckworth and Co., 1907, xx. and 472 pp. (92 figs.).

MORINI, F.—**Osservazioni sulla vita e sul parassitismo di alcune specie di Piptocefali.** (Observations on the life and parasitism of some species of *Piptocephalus*.)
[The author describes the host and parasite, and he also describes the zygospores of *Piptocephalus fusispora*, which are rare.]
Mem. Acad. Bologna, ser. 6, ii. (1905) 1 pl. See also *Bot. Centralbl*, civ. (1907) p. 290.

NICOLLE, CHARLES, & PINOY—**Sur les fructifications pathogènes à l'intérieur même des tissues chez l'homme.** (Pathogenic fructifications in human tissues.)
[The writers have found the fungus causing mycetomy, forming spores; they have named it *Oospora mycetomi*.]
Comptes Rendus, cxliv. (1007) pp. 396–7.

PECK, CHARLES H.—**Report of the State Botanist, 1905.**
[Twenty-two new species of fungi have been added to the flora. These are illustrated by thirteen coloured plates.]
Bull. New York State Museum, cv. (1905) pp. 1-106.
See also *Bot. Centralbl.* civ. (1907) p. 159.

RACIBORSKI, M.—**Ueber die Assimilation der Stichstoffverbindungen der Pilze** (The assimilation of nitrogen compounds in fungi.)
[Results of cultures of various fungi with nitrites, ammonia, etc.]
Bull. Acad. Cracovie Sci. Nat. Phys., 1906, pp. 733–70.
See also *Bot. Zeit.*, lxv. (1907) pp. 81–3.

RAJAT & PÉJU—**Quelques observations sur le parasite du Muguet.** (Some observations on the parasite of Lily of the Valley.)
[The fungi on the plant take the form of yeasts or of filaments.]
C.R. Soc. Biol. Paris, lx. (1906) pp. 1000–1.

SARTORY, A.—**Étude d'une Levure nouvelle.** (Study of a new yeast, *Cryptococcus salmoneus*.)
[It forms colonies of a salmon colour.] *Tom. cit.*, pp. 850–1.
See also *Bot. Centralbl.*, civ. (1907) p. 315.

WILL, H.—**Beiträge zur Kenntniss der Sprosspilze ohne sporenbildung.** (Contributions to the knowledge of budding fungi without spore formation.)
Centralbl. Bakt., xvii. (1906) pp. 428–45, 604–14, and (1907) pp. 693–712 (3 pls. and 14 figs.).

Lichens.

(By A. LORRAIN SMITH.)

Rhizoids of Granite-inhabiting Lichens.*—E. Bachman remarks on the extreme difficulty of examining such delicate structures as rhizoids and hyphæ in so unyielding a substance as granite. He found that the easiest way to attack the problem was to examine the mica crystals. When these crystals are parallel with the surface the hyphæ are spread over them. When the crystals are at right angles to the surface or in a slanting position, it is found that they are pierced and split into many folds by the penetrating rhizoids and gonidia. In time, owing to the action of the lichen, the mica loses its shining appearance, and becomes white like chalk. This change has been traced to a depth of 4 mm., but it varies with the nature of the granite and with the lichen species. It seems to be proved that chemical action by the hyphæ on the crystals results in the formation of minute openings and channels in the mica; these become filled with water and afford a satisfactory condition for further growth and penetration of the hyphæ. This results in the splitting apart and the disintegration of the crystal, and a subsequent still more luxuriant development of the plant. In comparison with chalk-inhabiting lichens, it is found that, while the latter have a well-developed independent gonidial zone in the substratum, in the granite there is, at most, only an occasional layer of green cells, and these always connected with the surface layer. The rhizoidal portion of the lichens is formed of three principalco nstituents: (1) Delicate colourless hyphæ with long cells, richly branched and often anastomosing; (2) short-celled, thick-walled, green, brownish-green, or brown hyphæ, sometimes necklace-like, connected with the protothallus; and (3) globose cells which have been found in almost all the lichens examined. They are filled with oil, and are comparable with the oil-containing cells of other lichens, especially of those that are found on chalk or limestone. In the case of the latter the thallus is almost entirely imbedded in the rock, and does not differ in structure from the external layers. The author has studied the effect of the rhizoids on other granite crystals, though not so fully, and comes to the general conclusion that splitting of the crystal is the method by which the lichen penetrates the substratum. These loosened areas are found to be filled with a mass of hyphæ and gonidia.

Bachmann closes the paper by a detailed account of the different lichens he examined, and the points to be noted in connection with each species. These were: *Sphyridium byssoides*, *Aspicilia gibbosa*, *Rhizocarpon geographicum*, *Acarospora discreta*, *Pertusaria corallina*, and *Rhizocarpon atroalbum*, all of them crustaceous forms.

Symbiosis in Lichens.†—A. Elenkin has written a paper on the conception of symbiosis as a "movable equilibrium of the symbionts." If, he says, we could conceive a state where the conditions of life

* Jahr. wiss. Bot., xliv. (1907) pp. 1–40 (2 pls.).

† Bull. Jard. Bot. St. Pétersbourg, xi. (1906) pp. 1–19. See also Bot. Centralbl., civ. (1907) pp. 175–6.

would be equally favourable for both partners, we should get mutualism; but the conditions always favour only one, and it gains an advantage and preys upon its symbionts. Unless the balance is redressed, the complete destruction of the weaker is certain, and is followed by the death also of the stronger. He compares the symbiotic life to a pair of balances, of which the scales move up and down, but are rarely horizontal. This is true also of parasitism; it is a balance between host and parasite which is to overcome the other.

Anatomy of Collema.*—Hue has examined microscopically the thallus and fruits of a large number of Collemas, and publishes an account of his observations. He gives measurements of hyphæ and gonidia, describing the position of these constituents. The form and dimensions of the apothecia, spores, paraphyses, etc., are also carefully set down. Several new species are described, and others critically examined.

Parmelia physodes.†—J. A. Vereitinoff distinguishes three distinct varieties in this species, which he describes according to the form and position of the soredia. In the typical form the outbursts of soredia occur in incisions at the edge of the thallus. In another they take the form of protuberances of a helmet shape. In still another variety the soredia are developed on the surface of the thallus. The author found no transition forms between *P. physodes* and the variety *tubulosa*. He is inclined to give the latter specific rank.

CUFINO, LUIGI—**Un manipola di Licheni dei dintorni di Napoli.** (A few lichens from the neighbourhood of Naples.)
[A small collection of lichens made by Cufino himself.]
Malpighia, xx. (1906) pp. 339–44.

PAUL, JOSEF—**Zur Flechtenflora von Mähren und Osterr-Schlesien.** (The lichen-flora of Mähren and Austrian Silesia.)
[The writer does not claim completeness for his list, but prints it as an incitement to further effort.]
Verh. Natur. Ver. Brünn, 1905 (1906) pp. 80–90.

WAINIO, ED. A.—**Lichenes novi rarioresque.** (New and rare lichens.)
[A number of new species collected by J. Schmidt in the East are described.]
Hedwigia, xlvi. (1907) pp. 168–81.

Mycetozoa.

(By A. LORRAIN SMITH.)

Studies in Myxomycetes.‡—This sixth contribution by E. Jahn on the subject of Mycetozoa is devoted to a study of nuclear fusion and reduction divisions. Helene Kranzlin, in her work on the development of the sporangia of *Trichia* and *Arcyria*, had noted the presence of degenerate nuclei, and Jahn has followed up the history of these nuclei. They are noticeable in a very early stage by their smaller size. The large nuclei present in the sporangia had arisen from the fusion of two ordinary nuclei; the degenerate nuclei were those that had been left

* Journ. de Bot., xx. (1966) pp. 77–96.
† Bull. Jard. Imp. Bot. St. Pétersbourg, xi. (1906) pp. 128–32. See also Hedwigia, xlvi. (1907) Beibl., p. 61.
‡ Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 23–5.

unpaired. The fused nuclei increase to a large size, and on division the daughter nuclei possess eight double chromosomes; these become the spore-nuclei. Jahn considers this process as homologous with the heterotypic division in the "gonotokonten" cells of Metaphytes and Metazoa, though the nuclei are too minute for detailed observations. The spore goes into resting condition and the first division of the nucleus of the amœba or zoospore which issues from the spore should be a reduction division. Jahn thinks he has proof of this: the daughter-nuclei show four chromosomes (double-chromosomes) the reduced number. In Myxomycetes we thus find the reduction process during the resting stage. In the protophytes, especially in fungi, spore-formation follows immediately on karyogamy. Jahn then describes the stages that occur in *Ceratiomyxa*, a primitive mycetozoon. They are different, inasmuch as there is karyogamy in the early stage, then karyokinesis, before spore-formation, which is a reduction division. The spore nucleus increases in size and divides twice, forming four nuclei; these divide again on germination.

Grass-killing Slime Mould.*—J. W. Harshberger notes the instance of parasitic slime moulds, *Plasmodiophora brassicæ*, which attacks cruciferous plants, and *Dendrophagus globularis*, which enters the stems of young cherry, plum, peach, and apricot trees. He then goes on to describe a disease that had attacked the grass on a lawn, large patches being blackened and the blades of grass destroyed. On examination he found this was due to the presence of *Physarum cinereum*. The author does not describe the kind of injury inflicted, whether it was only a smothering of the grass or a feeding on it. He rather implies the latter, as he says the plasmodium had left its saprophytic habit and assumed a grass-killing one. The roots of the grass were uninjured, and the leaves grew again very quickly.

SCHROEDER, H.—**Ueber den Nachweis einiger Enzyme in dem Fruchtkörper der Lohblüte (Fuligo varians).** (Proof of the existence of an enzyme in the fruit-bodies of *Fuligo varians*.)

[The author found an enzyme in the fruit-bearing plasmodia of the mycetozoon.] *Beit. Chem. Phys. Path.*, 1907, p. 153.
See also *Bot. Zeit.*, lxv. (1907) pp. 67–8.

Schizophyta.

Schizomycetes.

Pedioplana Haeckeli and Planosarcina Schaudinni.†—M. Wolff describes two new motile members of the Coccaceæ. (*a*) *Pedioplana Haeckeli* forms motile colonies on rotten turnips; the colonies are more or less rectangular plates and are moved by very long flagella (27μ, or fifty times the diameter of the coccus); the motility becomes more active on increasing the alkalinity and on warming to 30° C. The size of the individual cocci diminishes with the generation; they are separated in the colonies by refractile lines of intercellular matter, which increases with the generation to twice the breadth of the coccus. The organism

* Proc. Amer. Phil. Soc., xlv. (1906) pp. 271–3.
† Centralbl. Bakt., 2te Abt., xviii. (1907) p. 9.

grows slowly on nutrient agar, forming minute sharply contoured whitish circular colonies; it is a strict aerobe; it grows more quickly on turnip-agar, less well on gelatin; it also grows in broth, alkaline hay infusion, and in glucose solution, in which last the flagella are thrown off. The author discusses the systematic position of this organism, and concludes that it should be placed between the Planococcaceæ and the Planosarcinæ.

(b) *Planisarcina Schaudinni* was found in refuse-heaps, on decayed potato much eaten by worm and larvæ, and was associated with many putrefactive bacteria. Individual cocci are surrounded by a membrane or capsule about 0·2μ thick; each coccus has one long flagellum (14–16 μ), which seems to be continuous with the protoplasmic network of the cell. Motility is very active, especially in weak alkaline fluid media at 27°–30° C., and resembles the movements of some of the Ciliata. The organism is a potential aerobe; in the track of a gelatin stab culture small brown granular colonies appear, the medium being unclouded and not liquefied; on the surface of gelatin and agar plates after two days it forms small spherical coarsely granular colonies.

Bacteria of Spirit-vinegar and Wine-vinegar.*—W. Henneberg describes the cultural and biological characters of three new species of bacteria occurring in the fabrication of spirit-vinegar, (*B. schuzenbachi*, *B. curvum*, *B. Orleanense*) and two new species that occur in the fabrication of wine-vinegar (*B. xylinoides*, *B. xylinum*, *B. vinum acetati*.)

B. schuzenbachi forms on wort-gelatin clear round shining colonies with yellowish-brown centres; on beer-gelatin with or without the addition of 10 p.c. cane-sugar, the colonies are white with granular surfaces; pellicle formation on fluid media is variable, and in old cultures this takes a red-brown colour. The cells are oval, and often sickle-shaped or irregularly curved with rounded or pointed ends, two or more being arranged in chains, the members of the same chain having often very different forms. It does not grow at 37° C., but thrives well at 25°–30° C.

B. curvum forms on wort-gelatin round transparent colonies with raised margins and centres, often also white and dry colonies. The cells are oval or elongated with round or pointed ends, and often markedly bowed; long and short chains and threads of cells are observed; in old agar cultures the cells are often small and round; when grown on wort with the addition of 3 p.c. alcohol the cells have an invisible slimy surface that causes them to adhere together; the optimum temperature is 25°–30° C.

B. orleanense on wort-gelatin forms irregular whitish colonies; the cells are coccal-like or rod-shaped, with many intermediate forms; the rods are straight or curved, single or arranged in chains; the optimum temperature is 25°–30° C.

B. xylinoides forms on wort-gelatin colonies like drops of water, often with a light brown nucleus in the centre; the pellicle formed on fluid media is very varying in consistence, being either thin and rather dry or thick and slimy, with all intervening grades; the cells

* Centralbl. Bakt., 2te Abt., xvii. (1907) p. 789.

are round or rod-like, straight, bowed or irregular, single or joined in pairs or chains; optimum temperature is 28° C.

B. xylinum on wort-agar forms moist, light brown round colonies, raised at the centre and with granular surface; the pellicle formed on fluid media is at first clear, later whitish, thick, and leathery, and in cultures several days old it cannot be broken by the platinum needle. The cells are usually elongated, short or long rods, or threads, often spirally or irregularly curved; it grows well at 26°–32° C., and in sugar-yeast water at 35°–38° C.

Colouring-matter of Bacillus pyocyaneus.*—J. de S. Palma observed on the surface of agar cultures of *B. pyocyaneus* small pale greenish-yellow needle-like crystals arranged in rosettes, the medium itself being dark green and later becoming brown. From month-old cultures the colouring matter was extracted with chloroform, and after evaporation a brown-green mass was obtained, which when treated with alcohol became green in colour; the undissolved remains were repeatedly washed and crystallised from warm dilute alcohol, and clear pale yellow needles with a fusing point of 239° C. resulted.

By growing the organism on various chemical media it was shown that neither sulphur nor magnesium were required for the production of the green colour. The above described yellow substance was treated with oxidising reagents without result, but a green coloration was obtained with reducing agents.

Pathogenic Violet Bacillus.†—M. A. Gauducheau isolated from well water a violet bacillus resembling *B. janthinum* (Zopf) and *B. violaceus manilæ* (Wooley). The organism is 1–3 μ long, motile, does not stain by Gram's method, and only with difficulty by methylen-blue, but is readily stained by crystal-violet and carbol-fuchsin: it grows rapidly on agar, broth, and potato at 20° C., more slowly on gelatin, which is liquefied; it coagulates milk and re-dissolves the casein; agar and potato cultures have a violet colour, and broth is clouded and has a violet pellicle; the cultures have an odour of bitter almonds.

The violet pigment is insoluble in water, ether, and chloroform, but is soluble in alcohol; it changes to green on the addition of soda. Introduced into a guinea-pig, the temperature of the animal is lowered by more than 10°, and death results. It is also pathogenic to rabbits. Subcultures of some colonies taken from the rabbit after death produced no pigment in broth, and the organism then appeared identical with *B. janthinum*.

Creatinin-forming Bacteria.‡—N. Antonoff differentiates certain bacteria according to their property of forming creatinin. To 5 c.cm. of a killed pepton-water culture is added 1–2 c.cm. of a 15 p.c. solution of caustic soda, and 7 drops of a freshly-prepared 10 p.c. solution of nitro-prussiate of soda; the presence of creatinin turns the fluid a ruby-red colour, which after 1–5 minutes changes to straw-yellow, and on acidifying with acetic acid it becomes green and gradually blue.

* Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) p. 417.
† C.R. Soc. Biol. Paris, lxii. (1907) p. 278.
‡ Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) p. 209.

Cultures of *B. coli* gave this reaction after 24 hours, and similar results were obtained by *B. pseudo-dysenteriæ* Flexner, and slightly by *B. typhosus* after 20–25 days, but *B. dysenteriæ* Shiga-Kruse and *B. paratyphosus* A and B gave negative results, as also did *Pneumo-bacillus friedlanderi* and *B. rhinosclerinum*; *Staphylococcus aureus* gave no reaction, but *Staph. albus* reacted positively; the *Vibrio choleræ* group gave positive reaction after 24 hours; *B. diphtheriæ* reacted only slightly after two weeks, whereas Hoffmann's pseudo-diphtheria bacillus gave a positive reaction after 3 days. Many creatinin-producing organisms are also vigorous acid producers.

Pfeiffer's Bacillus in the Blood and Spleen of Influenza Patients.* G. Ghedini in 28 cases of influenza found the specific bacillus in the blood 18 times (64 p.c.), and in 14 cases, in the spleen 8 times (57 p.c.). The bacillus was found in the spleen in all cases in which it occurred in the blood.

Streptococcus mucosus capsulatus.† — L. Scheuer has isolated a variety of this organism from pus from the middle ear taken post-mortem from a child dead from typhoid. It presented long cocci of the size of *Diplococcus lanceolatus*; it stained badly by Gram's method; formed round convex finely granular yellow-brown colonies on agar; on gelatin the colonies are drop-like and transparent, later becoming opaque, the medium not being liquefied; milk is coagulated by fourth day; broth is clouded, and has a shining pellicle and abundant deposit; no indol is produced; it is pathogenic for white mice; it grows on blood media both with and without hæmolysis, either producing or not producing a green colouring matter, and independently of its pathogenicity for man.

Presence of Tubercles in the Lacteals of the Villi of the Intestine in Tuberculous Infections.‡—A. E. Metham fed a rabbit upon the material obtained from the tuberculous mammary gland of a cow, and killed the animal 38 days later. The intestinal lesions were especially extensive in the neighbourhood of the ileocæcal valve, and on the edge of the lesion, where the villi were intact, the author found tubercles in the lacteals.

Studies in Tuberculosis.§—A. E. Metham inoculated a heifer in the auricular vein with 5 c.cm. of a broth culture of avian tubercle obtained from the liver of a turkey, the animal being previously submitted to the tuberculin test with negative results. Twenty-one days later symptoms of general infection supervened, and at the autopsy there was found tuberculous broncho-pneumonia, and young tubercles in the liver and spleen. The author also administered 20 c.cm. of the same culture to a young bull by means of a stomach-pump. The symptoms in this case were less marked, being shown chiefly by abnormal fluctuations of temperature, and by a positive tuberculin reaction, which was obtained within two months after inoculation. The test applied four weeks later gave a negative result, and the animal was killed. The autopsy showed

* Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) p. 407.
† Tom. cit., p. 332.
‡ Proc. R. Irish Acad., xxvi. Sec. B (1907) p. 72. § Tom. cit., p. 67.

lesions of the mesenteric glands, but no tubercle elsewhere. Inoculations from these infected glands into a rabbit were without effect, the inference being that the lesion was innocuous, and that the animal had recovered from the infection.

Purification of Water by Ozone.*—D. Rivas finds that, under favourable conditions, ozone reduces the number of bacteria in water, and eliminates the *Bacillus coli communis*. It oxidises ammonia-forming nitrates. When the water was rich in organic matter the germicidal and chemical actions of ozone were only partial. The author considers that ozonisation is a favourable method for the purification of water such as is usually obtainable for a town supply. He gives detailed descriptions of his methods for obtaining and applying the ozone.

* Centralbl. Bakt., 2te Abt., xvii. (1906) p. 506.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(3) Illuminating and other Apparatus.

Beck-Thorp Diffraction Spectroscopes.†—This series of spectroscopes is claimed to be the first serious attempt to apply the advantages of the diffraction grating to the whole field of spectroscopic research. The list includes small instruments to be carried in the pocket of those interested in colour-printing or in chemical or colour industry, as well as more perfect instruments with scales of measurement. These latter include a chemical spectroscope of great dispersion, a sun prominence spectroscope, and a wave-length spectroscope for determining the wave-length of light with great accuracy. Of these we give the following examples.

The Beck-Thorp "Minimum" Pocket Diffraction Spectroscope (fig. 51) gives a dispersion of about 20° or about double that of the

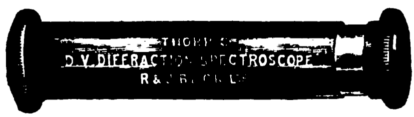


Fig. 51.

ordinary direct-vision prismatic instrument. It will readily show the more prominent Fraunhofer lines, and the rainband lines distinctly.

The Beck-Thorp "Regular" Pocket Diffraction Spectroscope (fig. 52) has a dispersion of about 30° and shows hundreds of lines in the solar

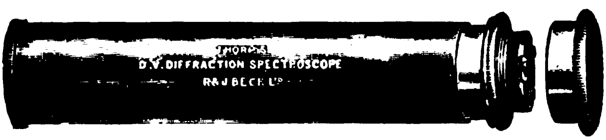


Fig. 52.

spectrum, the D line being well separated. It has an adjustable platinoid slit and a sliding focusing adjustment.

The Beck-Thorp Patent Reading Pocket Diffraction Spectroscope (fig. 53) has the same optical qualities as the foregoing but also an important addition. On looking through the instrument will be seen the spectrum and above it an illuminated arrowpoint. A graduated milled head moves this point along the spectrum and the position of

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† R. and J. Beck's Special Catalogue (1907) 8 pp. (9 figs.).

any line can thus be registered. The gradations of the revolving drum are observed through the lens by a slight shift of the eye, and in this way

FIG. 53.

the positions of numbers of lines can be rapidly recorded. The whole spectrum is divided into 500 divisions, and a glance at the sun at once gives the ratio that the scale bears to the actual wave-length.

FIG. 54.

Beck's Large Model Wave-length Diffraction Spectroscope (fig. 54). This instrument consists of a large collimator, a diffraction grating, and

an observing telescope with cross wires and rack-and-pinion focusing adjustment. It is of such precision that the various wave-lengths can be easily determined by its use. The observing telescope is moved by a micrometer screw which measures $e \sin \theta$ or the sine of the angle of rotation multiplied by the grating space in Angstrom units.

Expanding Spot for Dark Ground Illumination.*—W. R. Traviss describes in detail the construction of an ingenious expanding spot for dark ground illumination. The principle of the mechanism is the converse of that of the iris diaphragm, that is to say, the thin metal sheaves are so pivoted that instead of producing by their movement a circular opening of adjustable diameter, they produce an expanding disk.

The apparatus is built up on an ordinary "spot" such as is supplied by opticians, fitting into the "spot" carrier or swing arm of their condensers.

Round the spot are drilled a number of pivot holes, as near the edge as possible, one for each sheaf, the number being only limited by the skill of the workman, though 10 or 12 have been found in practice to give a sufficiently rounded disk (plate XV. fig. 6).

The sheaves are actuated by minute pins which fit each into a slot or groove on an upper or moving plate (plate XV. fig. 5), centred on the "spot," to which a lever arm is attached for the purpose. As this slotted plate turns the radial pins are forced to move along the slots or grooves and so the sheaves are uniformly and gradually expanded at the will of the operator.

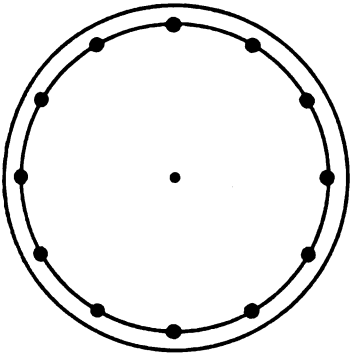
The mechanism, though exceedingly simple, depends for its efficiency on the accurate working of the individual sheaves. The method of securing this is as follows :—

A circular disk of metal, about 0·005 in. thick is taken and a concentric circle inscribed in it at the same distance from the edge as the centres of the pivot holes (plate XV. fig. 6). Starting from any point on this inner circle an arc is inscribed with a radius such that it passes a little above the centre (plate XV. fig. 6) [The part C E of the diameter A C represents the length of the slot (plate XV. fig. 5) and it will be obvious that the number of slots regulates the length of C E, for, as the number increases, so does the risk of their breaking into one another at the centre. These slots may be usefully replaced by radial grooves in a thicker piece of metal; this greatly increases the strength and rigidity of the apparatus.]

With centre B, the pivot at which the arc cuts the inscribed circle, and the same radius, another arc is inscribed and the sector between B and A is removed, leaving enough metal round the points B and A for the pivot and radial pinholes respectively, as shown in the shaded portions of fig. 3, plate XV. The resulting disk with sector removed as described constitutes a sheaf.

The number of sheaves required having been prepared, one for each pivot hole (plate XV. fig. 6) and a minute pin fixed in each, one up and one down as in plate XV. fig. 4 [the pins shown are intended to have their longer parts cut off flush with the sheaf, leaving the projecting points of

* English Mechanic, lxxxiv. (1907) pp. 596–7; see Journ. Quekett Micr. Club, x. (1907) pp. 77–82 (6 figs.).



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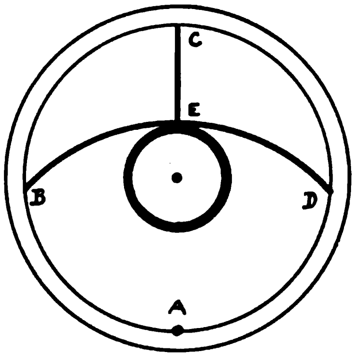

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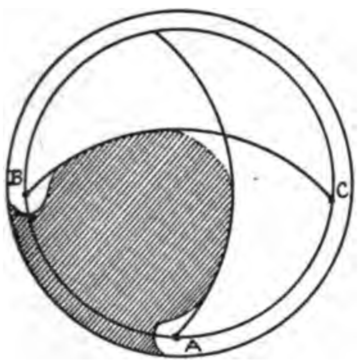

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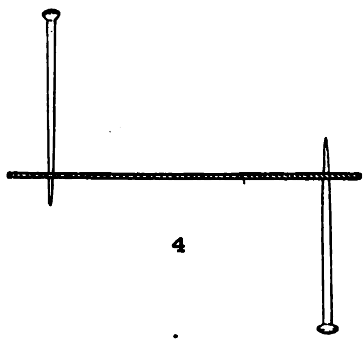

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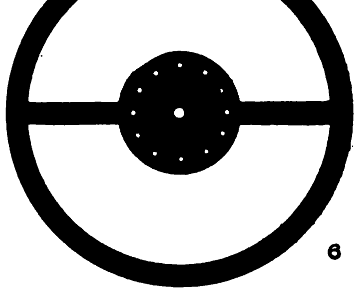

6

For the use of this Plate we are indebted to the courtesy of the Quekett Microscopical Club.

the length required,] it only remains to blacken the parts in the usual way and fit them together. In order to permit of easy adjustment to the "spot" carrier or swing arm, the ring which carries the spot is sawn through at one point so that it may be "sprung" into place.

The arc of movement is about 140°, and a stop-pin prevents any undue strain on the pins of the sheaves when the upper plate is slotted, or, if grooved to the edge, prevents them slipping out of their place.

Fig. 55.

A small piece of metal under the head of the centre pin acts as a spring, and serves to keep the sheaves under even tension during their movement, and at the same time prevents their displacement.

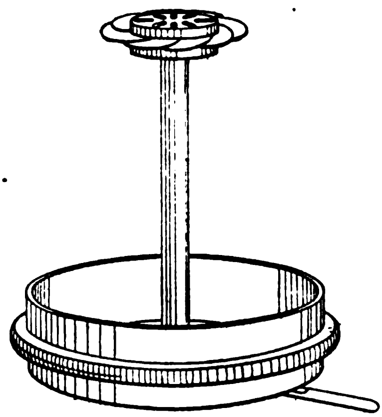

Fig. 56.

Figs. 55 and 56 show two methods of mounting the expanding spot, flat and on a stem, as originally constructed to suit a particular Microscope.

Description of a New Reflecting Condenser by means of which Ultramicroscopic Particles are made visible.—C. Reichert states * that

* Münchener Med. Wochenschrift, No. 51 (1906).

when R. Szigmondy and H. Siedentopf demonstrated their apparatus for rendering ultramicroscopic particles visible, at the meeting of the Naturforscherversammlung, in Cassel, they showed a new way for increasing the efficiency of the Microscope, and opened a new field for scientific research. The firm of C. Reichert, of Vienna, has given considerable attention to the manufacture and design of apparatus of this description ever since its introduction, and has endeavoured to simplify the same and make it more accessible and covenient in use. Various considerations and experiments have resulted in the new reflecting condenser.

This new method of rendering ultramicroscopic particles visible is

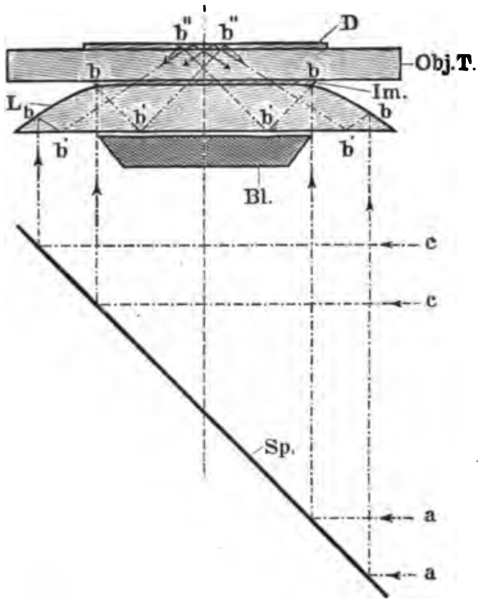

Fig. 57.

on the principle of dark-ground illumination, the light which illuminates the object having a greater aperture than the cone of light entering the objective which produces the image. This relation of the illuminating to the image-forming rays is the reverse of Siedentopf's method as practised at present. The first method has the advantage over the second of utilising the source of light much better. A second advantage consists in the fact that any dry objective can be used without any additions or alterations (such as stops, grinding part of front lens away, etc.) ; moreover the small particles are seen clearly without the disturbing diffraction rings which surround the images obtained with the Siedentopf apparatus.

This new reflecting condenser or spot-lens consists of a plano-convex lens from which the central portion of the curved surface is ground

away. The flat surface thus produced is exactly parallel to the plane surface of the lens. The remainder of the curved surface is silvered. The condenser is brought into optical contact with the object slip by means of a drop of cedar oil.

The path of the rays of light is shown in fig. 57. The rays (*a*) from the source of light are reflected by the mirror to (*b*), and thence to *b′* and *b″*. The rays *c* are likewise reflected to *b*, *b′*, *b″*.

The stop Bl. cuts off all the illuminating rays of less than 1·05 N.A. It is placed close to the under surface of the lens to prevent any disturbing reflections. This stop can be turned aside if desired and ordinary

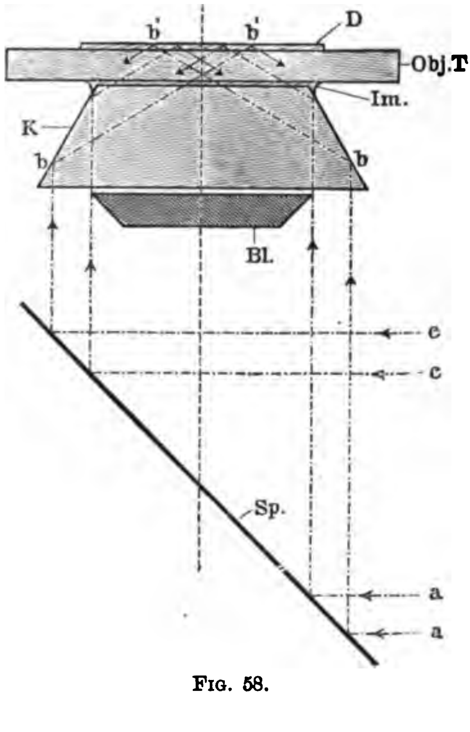

Fig. 58.

mirror illumination obtained. From fig. 57 it will be seen that all rays which enter the condenser of N.A. 1·05 to 1·30 are totally reflected by the upper surface of the cover-glass, so that it is quite impossible for these to enter the object-glass directly. The objective can only receive rays which, after reflection at *b″*, have impinged upon the particles of the object and have been diffracted by these from their original direction. These diffracted rays form the image in the Microscope. The reflecting surface of the condenser throws a well lighted image of the source of light in the plane of the object. The object must always be the same distance from the upper plane surface of the condenser owing to the short focus of the latter. This is easily managed by using glass slips of

a definite size, 2 mm. If this is not done the efficiency of the condenser is reduced—for instance, the small ultramicroscopic particles in the blood cannot be seen by the eye. This drawback led to the modification shown in fig. 58, in which the mirror-lens is replaced by a truncated cone. Inspection of the figure shows the path of the rays. The rays of light are less concentrated on the object, but it is not necessary to keep to a fixed thickness of the glass slide on which the object is placed. Slips from 1–2·5 mm. thick can be used with equal advantage. This latter condenser is specially recommended where sources of light sufficiently powerful are available. The condenser first described gives good results, not only with sunlight and the arc lamp, but also with less intense lights, such as small arc lamps, which can be used on any electric light circuit in place of the ordinary incandescent ones. Nernst lamps also give satisfactory results. Welsbach burners used with compressed coal gas are also practicable for ultramicroscopic work. Fig. 59 shows a

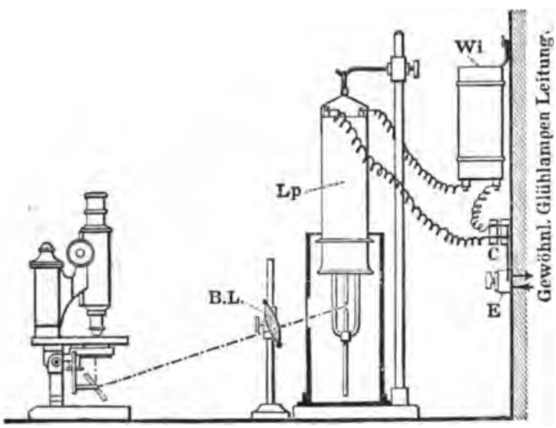

FIG. 59.

small arc lamp fitted up with a condensing lens. Fig. 60 shows the new reflecting condenser in a mount which can be used with any ordinary Microscope in place of the Abbe condenser.

Instructions for Use.—The reflecting condenser has proved of use for examination of (1) colloidal solutions, (2) blood, (3) every kind of unstained living bacteria, (4) transparent solid objects if thin sections can be cut. The most important point is to have the greatest possible cleanliness. Without this good results cannot be obtained. Small particles of dust, scratches, air-bubbles, and other imperfections in the glass slip or cover-glass have a very bad effect. For this reason only very good slides and cover-slips should be used. All objects, liquids, bacteria, etc., are simply placed on the glass slide and covered with a slip. It only remains to have a homogeneous connection, as free as possible from air-bubbles, between the top surface of the condenser and the lower surface of the slide. Cedar oil is best for

this purpose. It is necessary to use a low-power object-glass first in order to bring the image of the source of light to the centre of the field of view before proceeding to examine the object with higher powers. For the examination of colloidal solutions it is advisable to use small chambers on a glass slide, which after filling are covered with a slip. The depth of the chamber can be 0·1, 0·2 or 0·3 mm., as may be required, and the diameter 10 mm. When the liquid to be examined is placed on the slide and covered with a slip, it dries up quickly, but in these simple chambers it can be kept for hours in good condition. When

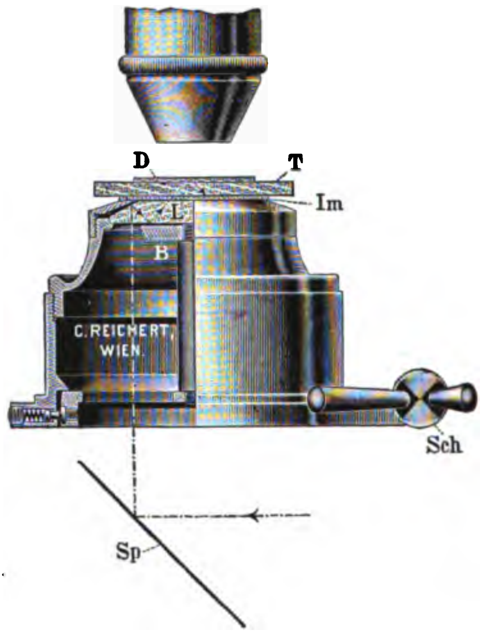

FIG. 60.

large quantities of liquids, or their mixture with other liquids, are to be examined, the arrangement shown in fig. 61 should be adopted. The liquid is forced to flow from one vessel to the other through a space in the centre of the chamber on the slide. The latter is very similar to those already described. For observing bacteria glass slides which have a small concavity ground in them are suitable. As a rule, however, the ordinary slides are all that is required. A drop of liquid containing part of the pure culture is placed on the slide covered with a slip. The flagella of several kinds of bacteria—for instance, *Spirillum volutans*—are distinctly seen by means of the reflecting condenser. It is, however, advisable to employ some means to reduce the extremely rapid movements. It seems also desirable that an imbedding material, the diffraction of which is very different from the

bacteria substance, should be found for each case. In the Pathological Department of the University of Vienna, A. Weichselbaum, and in the Clinic for Skin Diseases, Finger, and more recently Landsteiner and Mucha, have proved that this new instrument is very convenient for rendering visible the *Spirochæta pallida*. Further details are given in the "Wiener klinische Wochenschrift," 1906, No. 45.

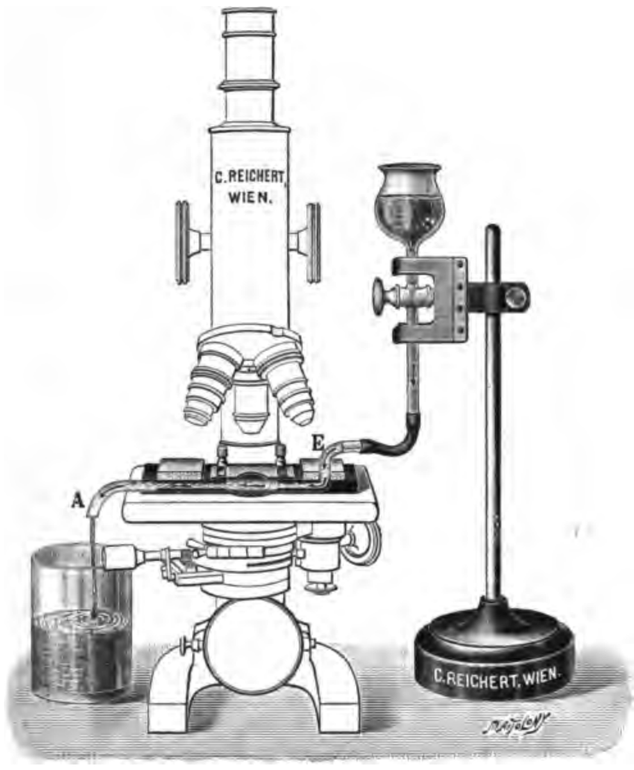

FIG. 61.

Pfund's Simple Photometer.*—A. H. Pfund has got very good results from the following simplified form of the Lummer-Brodhun type of photometer. A piece of plane glass about 2 mm. thick is silvered, highly polished, and then cut in two; the diamond scratch being made on the "glass" and not on the "silver" side. If the break is not perpendicular to the flat surface, that portion of the mirror is selected which has an acute angle at the edge of the silvered surface. Upon close examination, it will be found that the silver extends up to the very edge, and hence, by using this arrangement as a photometer,

* Johns Hopkins Univ. Circular, No. 186 (April 1906) pp. 20–22 (2 figs.).

it is easy to cause the line of demarcation between the two fields to disappear. The method of using the photometer is shown in fig. 62, in which s_1 and s_2 are the two sources whose intensities are to be com-

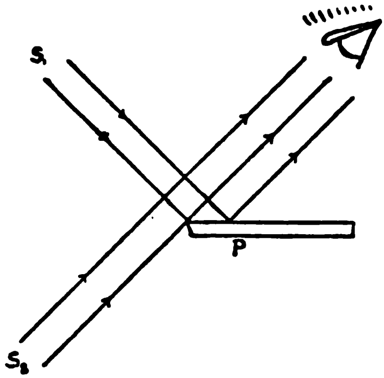

FIG. 62.

pared, and P the photometer. In addition to its simplicity and compactness, the other advantage claimed for this photometer is that it can be used under all conditions of angle which the two beams whose intensities are to be compared make with one another (with the exceptions, of course, of absolute normal and grazing incidence). A photometer of this kind has already been used in a determination of the distribution of light in the various spectra of a grating,* and has yielded very excellent results.

FIG. 63.

Swift's Pan-aplanatic Low Power Condenser.† This condenser (fig. 63), on the triple posterior system, is intended for use with medium powers whose N.A. does not exceed 0·66. It has a N.A. of 0·5, and is so corrected that the aplanatic aperture is within a trifle of its N.A.

(4) Photomicrography.

Selection of Plates and Filters for Photomicrography.‡—The firm of Wratten and Wainwright have issued a table of notes and instructions for the use of their plates and screens, which will, they think, enable the photomicrographer to obtain records of objects which he has long given up in despair.

* Astrophysical Journal, xxi. No. 2 (1905).
† Swift and Son's Special Catalogue, 1906, p. 50, fig. 54.
‡ Catalogue published by Wratten and Wainwright, Croydon (1907) 13 pp.

(5) Microscopical Optics and Manipulation.

Absorption Spectra of the Anilin Dyes.*—H. S. Uhler finds that methyl-green absorbs the extreme ultra-violet rays, and then transmits weakly in the vicinity of 0·35 μ. Then a strong band with its maximum at 0·415 μ extends from 0·36–0·45 μ approximately. This is followed by marked transparency to the green from about 0·45–0·495 μ. Finally, beyond 0·495 μ the longer waves are subjected to powerful absorption, with no return even to partial transparency in the visible spectrum.

Rhodamine B has a pair of beautiful distinct absorption bands at 0·524 and 0·557 μ. Of these, the more refrangible band has the greater intensity.

A Simple Way of Obtaining the Half-shade Field in Polarimeters.† The half-shade effect in polarimeters is usually obtained either by the well-known method of Laurent, or else by the more recent method of Lippich. In the former a quartz plate is employed to give the necessary rotation to one half of the beam of polarised light propagated through the instrument; in the latter, a Nicol prism additional to the polariser serves the same end. It occurred to J. R. Milne that the required effect might be obtained very simply by merely interposing a glass plate in the beam of light, so that half the beam traversed it in the oblique direction. It follows at once, from Fresnel's laws of the intensity of refracted light, that this will produce a slight rotation of the vibration-direction in the traversing half of the beam.

The author goes fully into the mathematical theory, and gives full details of the method in practice.

STREHL, K.—**Einführung in die beugungstheoretische Optik.**
[A series of elaborate articles.]
Central-Zeitung f. Opt. u. Mech., xxviii. (1907) Nos. 1, 2, 3, etc.

CLERICI, E.—**Sulla determinazione dell' indice di rifrazione al microscopio.**
Atti della reale Accademia dei Lincei, xvi. (March 1907) pp. 336–43 (3 figs.).

CESARO, G.—**Contribution à l'étude optique des cristaux en lumière convergente.**
Acad. roy. de Belgique, Bull. de la Classe des Sci., No. 5 (1906) pp. 290–34 (15 figs.).

(6) Miscellaneous.

Rowland's Ruling Machines.‡—J. S. Ames gives an account of the present condition of the three machines constructed by Professor Rowland. All have been found to be more or less out of repair, but two of them have been thoroughly overhauled. Several new and important improvements have been added, and gratings more perfect than any yet ruled can now be produced with a far less percentage of failure than was formerly possible.

Fluid Crystals.§—J. G. Adami and L. Aschoff record the interesting observations made in their respective laboratories at Montreal and Mar-

* Johns Hopkins Univ. Circular, No. 186 (April 1906) pp. 31–6.
† Proc. Roy. Soc. Edinburgh, xxvi. (1906) pp. 522–6 (2 figs.).
‡ Johns Hopkins Univ. Circular No. 186 (April 1906) pp. 62–5.
§ Proc. Roy. Soc., Series B. lxxviii. (1906) pp. 359–68.

burg on the myelins, myelin bodies, and potential fluid crystals. After noticing the physical and chemical characters of myelin, they enumerate the conditions under which myelin bodies may be found, and then point out that ofttimes they possess the property of double refraction. From this and other considerations the doubly refractive globules must be regarded as fluid sphero-crystals.

Investigation showed that a large number of substances of the nature of soaps gave this particular reaction; that the only crystalline fluids known which are in the intermediate state at the room temperature are certain of the oleic acid compounds; that fatty acid is an essential constituent of myelin, and that of the fatty acids oleic acid plays the most important part.

Quekett Microscopical Club.—The 438th Ordinary Meeting of the Club was held at 20, Hanover Square, the President, Dr. E. J. Spitta, F.R.A.S., F.R.M.S., etc., in the chair. A paper by Mr. James Murray, on "The Tardigrada," was read by Mr. D. J. Scourfield. The author gave a general account of the history of this group from the first mention in 1773 down to Richter's work of 1900. A general description of the group followed, and the paper concluded with some suggestions and hints on the collection of specimens. Mr. D. J. Scourfield, F.Z.S., F.R.M.S., read a paper on "An *Alona* and a *Pleuroxus* new to Britain." The first was *Alona weltneri* Keithack, closely allied to *A. costata*, and the second, *Pleuroxus denticulatus* Birge, a typically American species, but taken by Mr. Scourfield at Exminster, Devonshire, in August, 1905.

At the 439th Ordinary Meeting, held on April 19th, Mr. G. C. Karop, M.R.C.S., F.R.M.S., Vice-President, in the chair, Mr. D. J. Scourfield, after some introductory remarks on the group, read a paper communicated by Dr. Eugène Penard, of Geneva, on "The Collection and Preservation of Fresh-water Rhizopods."

GUYER, M. F.—**Animal Micrology: Practical Exercises in Microscopical Methods.**
Chicago, University Press; and London, T. Fisher Unwin: (1906) ix. and 240 pp.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Thermostat for Low Temperatures.†—W. Küntze has devised the following apparatus: A double-walled wooden box, 1·10 m. long, 0·85 m. deep, and 0·93 m. high, lined with zinc, and provided with wooden and glass doors, the space between the walls being 3 cm.; situated above and below are water tanks for cooling and warming respectively. The temperature of the warm tank is regulated by a gas regulator, whilst the temperature of the upper tank is regulated by the inflow of cold water from a water supply which is stopped or increased automatically by the action of an ether vapour regulator (fig. 64).

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.

† Centralbl. Bakt., 2te Abt., xvii. (1906) p. 684.

On warming above a certain temperature, the expansion of the ether vapour presses up a column of mercury against and closes the end of the tube *d*, whereby the stream of cold water is able to pass by the opening *e* into the upper tank; on cooling the mercury recedes, the tube *d* is opened, and and the water passes to a waste outside the tank. In order that the temperature of the lower reservoir may be lowered as quickly as possible, a tube passes from the cool tank through the lower warm tank, and as soon as the mercury column allows the cool water to enter the apparatus, the cool water passing through this tube from the upper tank will cool the lower warm tank before it leaves the apparatus by the outflow.

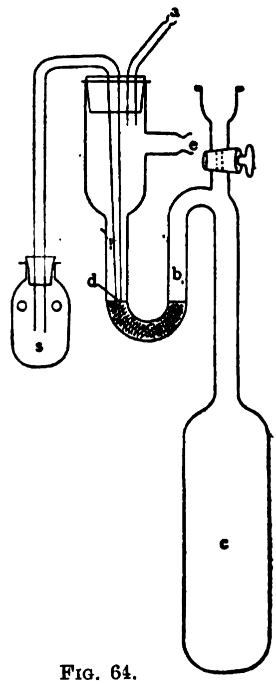

FIG. 64.

Cultivation and Preservation of Mycetozoa. — Microscopists interested in Mycetozoa often experience difficulty in obtaining specimens for study and preservation. Much time may be lost in looking for them, even at suitable seasons and in likely places. A. E. Hilton finds that this difficulty may be partially overcome by taking short pieces of branches, say about 8 in. long by 1·5 in. in diameter, keeping them moist, and examining them twice or thrice a week. In the course of ten days or a fortnight sporangia usually appear, occasionally in considerable numbers. Specimens of *Arcyria*, *Comatricha*, *Brefeldia*, and other genera have been obtained in this way. Branches found in Highgate Woods, treated in this manner, generally produce *Comatricha obtusata*. Pieces recently broken off, and partly covered with bark, give best results. The simplest method of keeping them moist is to take some ordinary glass jars, such as pounds of preserves are sold in; stand the pieces of branches on end, one in each jar; pour in water to the depth of an inch, and replenish from time to time as necessary. Another way is to take some shallow baking tins; cover the bottoms with "felting," or other fibrous material which will retain moisture; keep wet by adding water as often as requisite, and lay the pieces of wood side by side. Spring and autumn are the most favourable seasons for Mycetozoa, as cold, hot, or dry weather does not suit them.

Plasmodia of *Badhamia utricularis* can be cultivated from sclerotia, by moistening the latter in a dish along with fragments of fungi, either *Stereum hirsutum* or *Auricularia mesenterica*. A little water must be added occasionally, and a sheet of glass should be placed so as nearly to cover the dish and prevent too rapid evaporation. Plasmodia grow more rapidly on *Stereum* than on *Auricularia*; but care has to be taken to remove the pieces of *Stereum* when the plasmodia have passed over them, otherwise they are apt to putrefy, and may kill the plasmodia.

The best temperature for cultivation is 50°–55° F. When plasmodia are sufficiently developed, the withholding of food and gradual lessening of moisture induce the formation of sporangia.

To preserve sporangia for exhibition under the Microscope they must be set aside in a dry place until all moisture has evaporated, and should then be mounted in air, in deep glass cells. A good plan is to stick a small ledge of cork to the slip, a little below the centre of the cell, and stick the specimen upon the cork, in its natural position, supported by a portion of the leaf, bark, or other substance on which it has been found; shellac, or any other adhesive material commonly used, will serve the purpose: and, when quite dry, all can be closed in with a cover-glass. Such slides, however, must be protected from rough treatment, as a fall or jar is likely to cause frail sporangia to fall to pieces.

When under the Microscope, mounted in the manner described, the specimens should be brilliantly illuminated as opaque objects; and pleasing effects can be produced by placing behind the slide, and therefore out of focus, a piece of coloured paper, or white paper with a piece of blue or green gelatin laid upon it, to furnish a suitable background.

A New Apparatus for Studying Bacterial Enzymes.*—S. L. Schouten has devised the following method. The apparatus (fig. 65) is

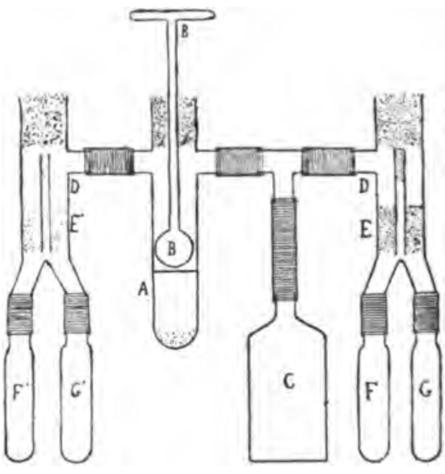

Fig. 65.

of glass, the dotted portions represent wool-corks, the line-shaded portions being rubber tubes. In tube A is a little glass powder on to which is poured a nutrient solution, in which the organism is to be cultivated; in F, G, F', G', is the material on which the enzyme is to act, and C contains water; the whole is sterilised, and the tube A inoculated. When sufficient growth has taken place water is poured from C on to the cork E until it is saturated, then some of the medium in A is poured

* Centralbl. Bakt., 2te Abt., xviii. (1907) p. 95.

on to E (avoiding any passing into C), half being allowed to filter into F, and half into G; F and G are then clamped and separated from the apparatus. The mycelium in A is now broken up by the rod B, water is added, and the washing passed on from A into F' and G' through the cork E.

Structure of Rhizobium Leguminosarum.*—R. Greig Smith, for the structural examination of this organism, advises the growing of large cells by use of agar containing maltose, citrate and sulphate of ammonium; and staining with fuchsin 0·1 grm., alcohol 10 c.cm., 1 p.c. phenol 90 c.cm. Add a loopful of slime to 4 c.cm. of distilled water in a test-tube warmed to 80° C. in water-bath; the slime is distributed in the water and a uniform suspension of the cells obtained: 2 c.cm. of the stain, at 80° C., is added, and the test-tube is kept at 80° C. for 4–8 hours. A drop of the suspension is then spread on a coverslip, dried in air, flamed, decolorised with 0·5 p.c. acetic acid, dried again, and mounted. When properly stained the rods are seen as bipolar staining spherules.

Action of Particulate Conditions on Microbic Cultures.†—P. Harckman inoculated with 1 c.cm. of well water each of three Petri dishes, containing respectively gelatin dissolved in pure water, gelatin dissolved in a solution holding particles of tin, and gelatin dissolved in a solution holding particles of leather. The gelatin and tin culture showed numerous vigorous colonies after four days, the medium being completely liquefied after fourteen days; the gelatin and leather culture manifested no growth within four days, and the gelatin and pure water showed only a few scarcely perceptible pin-point colonies. The colonies on the medium containing tin had the yellow colour of sulphide of tin and later the violet of oxide of tin. The author concludes that particles of tin are exciters to microbial growth; he found that manganese was also an exciter, but to a less degree than tin. The phenomenon is represented diagrammatically; regarding the living organism as positively electrified, and the particles of tin as negatively electrified, the excitation resulting from the induction of negative ions on the positive ions determines the excitation which governs the production of vital phenomena. The contrary effect results when the particulate ions have a positive polarity, as in the case of leather.

Detection of Bacillus typhosus.‡ — 1. *Cultivation of B. typhosus from the blood by means of bile medium.* H. Conradi recommends the following method for use by medical practitioners: 0·5 c.cm. of blood is taken from the lobe of the ear, mixed with 10 c.cm. of sterilised ox bile, and added to 10 parts of pepton and 10 parts of glycerin contained in an easily sterilised glass tube closed by a glass stopper; this is inclosed in a wooden case and sent to a bacteriological institute. There the tube is incubated at 37° C. for 16 hours, when subcultures should be made on litmus-lactose-agar. After 30 hours the diagnosis of typhoid is established.

* Proc. Linn. Soc. N.S.W., 1906, p. 295 (2 pls.).
† Bull. Classe des Sci., 1906, No. 5, p. 335.
‡ Centralbl. Bakt., Ref., xxxix. (1907) p. 395.

2. *Diagnosis of Typhoid.*—W. Pöppelmann* obtains blood from the finger under aseptic precautions, and prepares films which are dried in the air and placed in the septic solution (May-Grünwald) for 2–6 minutes, washed in distilled water, quickly dried, and examined under 1000 diameters without a cover-glass. Giemsa's stain may also be employed.

Canon† states that the above method has been used by Meisel and Almaquist for twenty years, and he considers that obtaining blood from the hand is a possible source of contaminating error.

3. *Malachite-green Media for the Detection of B. typhosus, B. coli, and B. paratyphosus.* J. Leuchs‡ employs the following preparation. 100 c.cm. of neutral dextrin broth agar, 0·5 c.cm. normal sodium carbonate solution, 10 c.cm. (10v H) nutrose solution, and 1·6 c.cm. of 0·1 p.c. solution of malachite-green. In this medium *B. paratyphosus* type B gave a vigorous growth, but the development of *B. coli* was completely arrested; the growth of three strains of *B. typhosus* was far superior to that on Drigalski-Conradi medium.

Lentz and Tietz§ find that malachite-green agar medium gives 37·7 p.c. better results for typhoid diagnosis than Drigalski-Conradi medium.

4. *Sodium Glycocholate and the Blood Cultivation of Typhoid Patients.* Roosen-Runge‖ modifies the method of Schott-Müller for obtaining cultures from the blood of typhoid patients, by using sodium-glycocholate agar:—1 litre broth, 20 grm. agar, 10 grm. pepton, 5 grm. sodium chloride, 10 grm. sodium glycocholate. By this means it was possible to obtain visible colonies in 13–16 hours; and also, the number of colonies was much greater—in one case as many as 1400 were counted on the fourth day, whereas on ordinary glycerin-agar there were only 800.

5. *Rossi's Typhoid Diagnosticum.*—G. de Rossi¶ prepares his diagnosticum as follows:—10 c.cm. of a broth culture of *B. typhosus*, grown for 1–2 days at 27° C., is transferred to a test tube, and placed for 1 hour in a water-bath at 58°–60° C. To one half of the contents is added a drop of normal serum, and to the other half a drop of the serum to be examined. After half an hour in a thermostat at 37° C. agglutination should result. The test remains reliable for 11 months or longer.

6. *Cultural Observations and Diagnosis of B. typhosus in Fæces, Soil, and Water, by the help of Malachite-green.*—F. Loeffler** finds that the action of this method consists in hindering the growth of accompanying germs, especially those of *B. coli*, and in causing a more vigorous growth of *B. typhosus*. The author gives receipts for the preparation of various green media by which the *B. typhosus* may be separated.

6. *Diagnosis of B. typhosus and B. coli by means of Sulphate of Copper and Prussiate of Potash.*—A. Marrasini and G. Schiff†† prepared peptonised nutrient media from meat extract, and added solutions of sulphate of copper or prussiate of potash to each. After inoculation and incubation at 37° C. for 36 hours, the tubes of *B. typhosus* were clear and

* Centralbl. Bakt., Ref., xxxix. (1907) p. 401.
† Loc. cit.
‡ Tom. cit., p. 396.
§ Tom. cit., p. 404.
‖ Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) p. 520.
¶ Tom. cit., p. 398.
** Tom. cit., p. 405.
†† Tom. cit., p. 409.

stained, whereas those containing *B. coli* were clouded and decolorised in the case of copper sulphate, and stained green by the prussiate of potash.

Modification of Fermi's Method for the Examination of Proteolytic Enzymes.*—S. L. Schouten adds water saturated with thymol to 7·5 p.c. of gelatin, and as much powdered cinnabar as will make the fluid deep red; by stirring well the cinnabar is prevented from settling, and the mixture is then poured through a long-necked filter into test tubes, about 5 c.cm. into each; these are then placed in a water-bath at 40° C., and then held for 10 seconds under a cold water tap, the gelatin being thereby thickened but not solidified; when the tubes are stood vertically there will be a thin elliptical layer of gelatin attached to the wall of the tube; when thoroughly cooled the fluid to be examined is introduced into the tubes, with an addition of a piece of thymol. The object of the method is that the enzyme comes into contact with a large surface of gelatin, which being in only a very thin layer can be quickly liquefied. All the tubes must be heated to the same temperature, and cooled for the same length of time. The author claims that by this method it is possible to determine after 12 hours whether an enzyme is present, and to estimate how quickly it acts.

Cultivating a Micro-organism found in the Blood in cases of General Paralysis.†—N. Sokalsky obtained blood from three cases of general paralysis, and inoculated tubes of agar, gelatin, potato and broth. Cover-slip preparations made after 24 hours in a thermostat and stained by Bocardi's method and with 1 p.c. alcoholic eosin, showed many round, highly refractile bodies inclosed in the red corpuscles, as many as 20 being contained in one cell; these bodies were larger than micrococci, stained badly with anilin dyes, but well with concentrated fuchsin, and by 1 p.c. alcoholic eosin; not staining by Gram's method.

Broth cultures remained clear with a slight deposit which is composed of the same round bodies arranged in pairs or in bundles like sarcinæ. Guinea-pigs inoculated subcutaneously with the broth culture developed paralytic symptoms, and the organism was re-obtained from the heart-blood after death.

Automatic Aerating Device for Aquaria.‡—L. Murbach obtained very gratifying results from the apparatus for aerating aquaria which he invented, and thus describes:

The things needed are a glass filter pump, two wide-mouthed bottles about 8 by 15 cm. and 6 by 12 cm., a cork stopper to fit the larger bottle, a stand with balance beam, glass and rubber tubing. The stopper is bored with three holes, 5 mm., 8 mm., and 11 mm. in diameter. Into the smaller holes are fitted a 24 cm. long tube for the air outflow, and a 15 cm. long tube for carrying the water from the filter pump. The 11 mm. hole is for a wooden rod 15 mm. in diameter and about 15 cm. long; this is cut down, tapering abruptly from 15 mm. to 8 mm. the rest of its length. The larger end of this rod serves as a valve in the 11 mm. hole in the stopper, being placed vertically so that the

* Centralbl. Bakt., 2te Abt., xviii. (1907) p. 94.
† Op. cit., 1te Abt. Orig., xliii. (1907) p. 213.
‡ Amer. Naturalist, xli. (1907) pp. 61–4 (1 fig.).

stopper can glide freely along the rod when placed in the inverted bottle. After inserting the glass tubes as shown in the illustration (fig. 66), the wooden rod is inserted through the stopper from the side that goes into the bottle; then the smaller end of the rod is attached to a block. The large bottle is suspended in an inverted position from one end of the balance beam of the stand, the stopper is inserted, and the small bottle, nearly filled with water, is hung on the opposite end of the beam for counterpoise. The block carrying the wooden rod is moved about on the base of the stand until the stopper moves easily up and

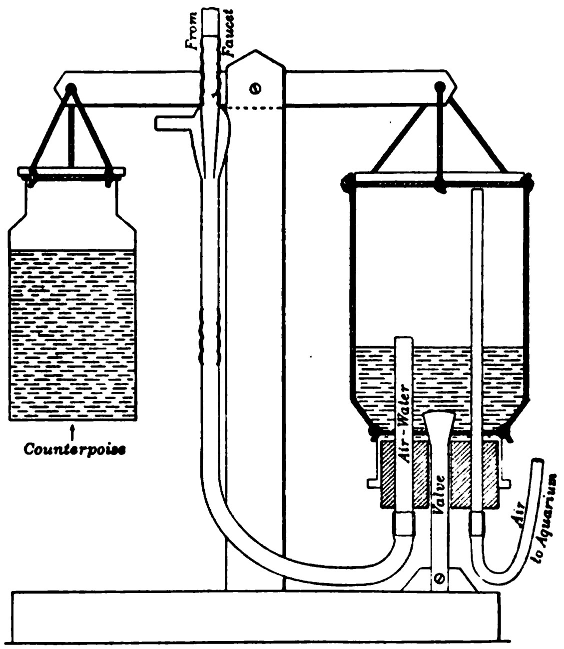

Fig. 66.

down the rod, and is then fastened in this position with a wood screw. If the head of the rod fits the hole in the stopper accurately no water will escape when it is turned on until the weight of water in the inverted bottle exceeds that of the counterpoise; the weight of the counterpoise may be adjusted so that it will keep the large bottle about one-third full of water, thus preventing the escape of air except through the proper outlet. The water and air should not discharge alternately, and if this take place a longitudinal groove may be cut into one side of the head in the stopper until enough water escapes to balance the inflow when the water pressure is at its lowest. From this point onward it will work automatically.

Simple and Rapid Method of Preparing Agar and Gelatin Media.*—Bissérié describes a simple method for making quite clear culture media.

The agar, gelatin, or any other medium is melted up in a water bath in a beaker A (fig. 67). When the medium is liquefied an inverted flask B is placed on the bottom. The mouth of the flask has been previously covered in the following manner. First, a layer of cambric (batiste) is tied on; over this is applied a disk of filter paper (chardin), and the latter covered and kept in place by means of another piece of cambric. The whole apparatus is then placed in an autoclave, which is heated at 100° (valve open) until all the air is driven out, then with the valve closed at 120°. By this means all the air in B is driven out and replaced by steam. After a few minutes at 120° the autoclave is allowed to cool. When the indicator points to zero the valve is opened very slowly, in order to let in air very gradually. In consequence of the cooling the atmospheric pressure drives all the hot liquid from A into B, and thus within half-an-hour may be obtained a perfectly clear and sterile medium.

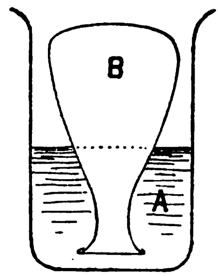

FIG. 67.

(2) **Preparing Objects.**

Observations on Bacterial Capsules.†—A. Hamm advocates the use of Weidenreich's method of fixation by osmic acid vapour for the examination of bacterial capsules. The author employs a tube in which the fixation may be carried out, which he considers to have advantages over the modified Petri dish devised by E. Levy. This tube is wide-mouthed and bulb-ended, and closed by a ground-glass stopper; the bulb is filled with glass-wool, which, after sterilisation, is impregnated with 1 p.c. osmic solution or 1 p.c. chromic acid. Cleaned slides are placed in the tube for 1–2 minutes, then taken out and filmed and replaced in the tube for 20–40 seconds, dried in the air and stained either by Klett's method or by Giemsa.

To demonstrate the capsules of bacteria from artificial media the films should not be made with water, but with some viscid fluid, such as blood serum or ascitic fluid.

The author considers that the capsule and the intracapsular network result from the production of slime by the organism. The capsule appears larger in young bacilli and diminishes with age. The substance of the capsule consists of nucleo-proteid and contains no mucin.

Studying the Heart of Arca.‡—A. Theiler first benumbed the animals either in 2 p.c. solution of cocain in sea-water, or 5 p.c. alcohol in order to prevent contraction. After 5 or 6 hours they were transferred to the fixative (sublimate with 5 p.c. acetic acid), by which the shell was at the same time dissolved.

* Ann. Inst. Pasteur, xxi. (1907) pp. 235–6 (1 fig.).
† Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) p. 287.
‡ Jen. Zeitschr. Natur., xlii. (1906) pp. 115–42.

For histological purposes, pieces with the heart attached were dissected out, and fixed in osmic acid or in Flemming's fluid. Smaller animals were decalcified after fixation by immersion in 70 p.c. alcohol with 2–3 p.c. sulphuric acid. As stains, borax-carmin, hæmalum, and various other varieties of hæmatoxylin, were used, and also contrast plasma stains; for histological purposes, iron-hæmatoxylin and van Gieson's method.

Demonstrating Trypanosomata.*—H. G. Plimmer has used the following method for some years and has found it to give uniformly good and accurate results. The specimen is never allowed to dry, there is no shrinkage of cells, and the finest cytological details can be observed. (1) Expose a coverslip to the vapour of osmic acid (1 p.c.) 1 c.cm., glacial acetic acid 3–5 drops, for 2 minutes. (2) Place a drop of fresh blood on one corner of the slip and expose again to the vapour for 30 seconds. (3) Spread the film carefully and expose again for 15–30 seconds to the vapour until the surface appears no longer moist. (4) Place slip in absolute alcohol for 10 minutes. (5) Immerse slip in faintly rose-coloured solution of permanganate for 1 minute (2–3 drops of 1 p.c. sol. to 50 c.cm. H_2O). (6) Wash in water for 5 minutes. (7) Stain in following modified Romanowsky, made by mixing just before use—azur i. (1 p.c.) 1 c.cm.; eosin B.A. (1–1000), 2 c.cm., H_2O 8 c.cm., for 15–30 minutes. (8) Wash. (9) Differentiate in orange-tannin 30 seconds. (10) Wash well and drain. (11) Absolute alcohol for a few seconds. (12) Alcohol-xylol (2–3) two or three changes. (13) Xylol; and mount.

Instead of 7–13 any other method of staining can be used, according to what structures it is desired particularly to show.

Studying Neurosporidium cephalodisci.†—W. G. Ridewood and H. B. Fantham describe a new sporozoon, *Neurosporidium cephalodisci*, which infests the nervous system of *Cephalodiscus nigrescens*. The specimens of *C. nigrescens* obtained by the "Discovery" were fixed, some in 5 p.c. formalin, some in Perenyi's fluid, and some in picric acid solution. Serial sections of the polypides were cut for the purpose of investigating the anatomical structure of this new species of *Cephalodiscus*, and these sections and some others were utilised for the study of the sporozoon. The majority of the sections (5–7·5 μ) were stained with Ehrlich's hæmatoxylin and eosin, others with hæmatoxylin and orange G, or Mayer's hæmalum, or borax-carmin.

Demonstrating the Fibrillary Structure of Nerve-endings in Cutaneous Tissue.‡—Eugen Botezat finds that the methylen-blue and the Golgi methods supplement one another in the study of nerve-endings. For the latter method he adopts the following procedure:—Pieces of quite fresh tissue, from 2–3 c.mm. in size, are immersed in about ½ litre of 1·5 p.c. silver nitrate, and incubated at about 37·5° C. for three days. On removal they are quickly washed in distilled water, and then placed in the reducing fluid. This consists of 1 grm. pyrogallic acid, 2·5 c.cm. formalin, and 50 c.cm. distilled water. In this they remain for about one

* Proc. Roy. Soc., Series B, lxxix. (1907) pp. 95–102 (1 pl.).
† Quart. Journ. Micr. Sci., li. (1907) pp. 83–4 (2 pls.).
‡ Anat. Anzeig., xxx. (1907) pp. 34–44 (9 figs.).

day, after which they are thoroughly washed in distilled water, and then passed through upgraded alcohols to dehydration. Then xylol, paraffin, sectioning, and mounting in Dammar. The author found Dammar was preferable to balsam, as it did not become yellow after lapse of time.

Studying the Life-history of Adelea ovata.*—C. C. Dobell obtained the best results by adopting Schaudinn's methods. The entire gut was removed, and the epithelial cells and the entire gut contents spread out upon a cover-slip. The films thus obtained were instantly fixed by immersion in hot sublimate-alcohol containing a trace of acetic acid. After fixation the films were treated with iodin-alcohol, and stained in Bütschli's modification of Delafield's hæmatoxylin. This is prepared by adding 1 p.c. acetic acid to a 0·5 p.c. Delafield's hæmatoxylin in water until a pink colour is produced.

Staining for all stages, except spores, is complete in from 15–30 hours. Giemsa's stain was not satisfactory. Cross-sections of the gut were unsatisfactory. Moist films were more useful for examining the coccidia.

Studying Spermatogenesis of Myriapods.—M. W. Blackman† found that for fixing the spermatocytes of *Lithobius*, the best reagent was Gilson's nitric-acetic-sublimate mixture. The most satisfactory staining results were obtained with Heidenhain's hæmatoxylin, used either alone or with Congo-red as a counter-stain. For micro-chemical tests Flemming's three-colour stain and the Ehrlich-Biondi mixture was used, the results obtained with the latter being especially satisfactory.

(4) Staining and Injecting.

Criticisms of the so-called Syphilitic Spirochæte.—Th. Saling‡ insists on the nerve-end nature of the "pallida" and "silver" spirillæ. The finding of these in the lumen of the blood-vessels he regards as artificial and accidental, and he refers to their rarity in those tissues in which nerve-endings are scarce. He gives photographs of silver spirillæ seen in the stomach-wall of a healthy rabbit, which may readily be mistaken for spirochætes; here elastic fibres are common and nerve-fibres less so. In a photograph of healthy rabbit pancreas spirochætal forms are shown that are probably nerve-fibrillæ. From a diagnostic point of view, the author refers to the fact that in recent syphilis "pallidæ" can be found only in 39·6 p.c. of the cases; and often these are confused with *Spirochæta refringens*; severe cases of syphilis are reported in which no "pallidæ" could be demonstrated, and cases of not acknowledged syphilis where "pallidæ" were found.

Reply to Saling's Criticism of the "Pallida."—M. Wolff § charges Saling with stating a hasty opinion from ill-prepared specimens, and challenges him to demonstrate his spirochætal-like nerve-fibrillæ in section of skin of a non-syphilitic animal. The author further considers that Saling does not show by his figures that he has made any real nerve impregnation.

* Proc. Roy. Soc., Series B, lxxix. (1906) pp. 155–63 (2 pls.).
† Proc. Amer. Acad. Arts and Sci., xlii. (1907) pp. 489–518 (2 pls.).
‡ Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) p. 362.
§ Tom. cit., p. 222.

Reply to Wolff's Article relating to the Spirochæte Question.—Th. Saling * maintains that the spirillæ are maceration products, and represent nerve-endings. The author claims that he is supported by Levaditi and Hoffmann, and that Wolff has not made control experiments, and forms his opinion from a neurological point of view.

Transmission of Siphilis to Rabbits.†—E. Bartarelli succeeded in a number of experiments in producing syphilitic keratitis in rabbits, by injecting syphilitic material into the anterior chamber of the eye. In each case spirochætæ were found at a certain distance from the site of the lesion, but not in the lesion itself. Although the symptom complications associated with syphilis were not met with, the author considers that etiologically the lesion was of a syphilitic nature. The lesion was successfully transferred from rabbit to rabbit, with the production of a typical spirochætal keratitis.

Staining Animal Parasites.‡—T.W. Hall stains films of blood, fæces or sediment of secretion for ½–2 minutes, with 1 p.c. aqueous methylen-blue 100 c.cm., glacial acetic acid 5 c.cm. The film is then contrast-stained with saturated alcoholic-eosin solution, used hot in the usual way. The film is then fixed in potash-alum solution for ½–2 minutes, and, after decolorising in alcohol, is mounted in balsam.

Metallography, etc.

Crystallisation and Segregation of Steel Ingots.—J. E. Stead § gives the methods he uses for developing the macrostructure of steel. By etching complete sections of rails, billets, etc., with nitric acid or other suitable reagent, the position of segregated portions resulting from the crystallisation during solidification is made evident. A classification into micro-, minor, blowhole, and axial segregations is given. The author's experiments appear to show that cavities formed in steel by the evolution of gas during solidification are frequently filled up by the still liquid portion ; blowhole segregations thus result. By the addition of aluminium to the molten steel, the formation of blowholes, and thus of blowhole segregation, may be prevented. Sulphur segregates the most, phosphorus and carbon follow in that order; manganese and silicon do not segregate to any material extent.

Piping and Segregation in Steel Ingots.—H. M. Howe ‖ discusses at some length the causes of piping and segregation, and the methods of restraining these evils. Piping is due chiefly to virtual expansion of the outer walls of the ingot during solidification, and not to a change of volume accompanying the change from the liquid to the solid state. Among the means suggested for lessening piping are casting with the large end up, liquid compression, and devices for retarding solidification such as casting in wide ingots, or in sand moulds. Segregation may be

* Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) p. 229.
† Tom. cit., p. 238. ‡ Brit. Med. Journ., 1907, i. p. 556.
§ Cleveland Inst. of Engineers (1906) 54 pp., 25 figs. Includes the substance of two papers, one read before the British Association, August 1906.
‖ Bull. Amer. Inst. Mining Engineers (1907) pp. 169–274 (36 figs.).

dealt with either by reducing its amount or by raising the position of the segregate. The degree of segregation is lessened by addition of aluminium to the molten steel and by hastening solidification.

Chromium-Tungsten Steels.—L. Guillet* has examined microscopically 24 steels containing carbon 0·14–0·84, chromium 0·7–21, and tungsten 2–20 p.c., after different heat treatment. Among the author's conclusions are: (1) the constituents present in the normal steel are pearlite, martensite, and a triple carbide of iron, chromium and tungsten, accompanied by martensite, sorbite (or troostite) or γ-iron; (2) the most frequently observed structure of the normal steels resembles that of high speed tool steels—grains of carbide in a matrix of troostite or sorbite. The mechanical properties on the whole are such as might be expected from the micro-constitution and from the author's previous results on chromium steels and tungsten steels. The effect of quenching at different temperatures and the bearing of the numerous facts observed on high-speed steels, are discussed at some length. In the steels containing carbide that constituent could be caused to disappear by heating at 1200° C. for a sufficiently long time; on quenching, an extremely fine martensite resulted.

Alloys of Manganese and Copper.—S. Wologdine† has determined the freezing point curve and investigated the microstructure and hardness of a series of manganese-copper alloys. The melting point of manganese was found to be 1275° C. The alloys are classified in three groups—(1) 0–40 p.c. manganese, apparently solid solutions of manganese in copper; (2) 40–78 p.c. manganese, very hard and brittle, containing two constituents; (3) 78–100 p.c. manganese, also hard and brittle and falling to powder in air. The most satisfactory etching reagents were a very dilute solution of ammonium sulphide in water, boiling water (which attacks manganese), and for the groups (2) and (3) iodine solution. A maximum in the freezing point curve at 1140° C. and 78 p.c. manganese is ascribed to the compound Mn_4Cu. Two minima exist, at 40 p.c. (850° C.) and 89 p.c. manganese (1005° C.). The latter is a eutectic point. Hardness was measured by the Brinell method.

Metal-testing Laboratory.‡—L. Guillet describes the equipment of the temporary laboratory fitted up at Brussels for the Congress of the International Association for Testing Materials, in which were given demonstrations of modern methods of testing. The tests were made with great rapidity and considerable accuracy, and comprised—(1) Preparation of polished and etched sections and of photomicrographs of these; (2) critical point determinations by the Saladin method; (3) shock tests on notched bars in the Guillery machine; (4) Brinell hardness measurements; and (5) shearing tests by Fremont's method. Thirty-six samples were tested in the four days during which the laboratory was working. The principal etching reagents used were picric acid for iron alloys and ferric chloride in hydrochloric acid for alloys of copper.

* Rev. Métallurgie, iv. (1907) pp. 5–24 (16 figs.).
† Tom. cit., pp. 25–38 (13 figs.).
‡ Tom. cit., pp. 189-200 (10 figs.).

Alloys of Nickel and Tin.*—E. Vigouroux prepared three alloys containing respectively 7, 16, and 26 p.c. nickel, and investigated the action of acids upon them. By alternate digestion with nitric acid and fusion with potassium hydrate the compound NiSn was isolated. When the pure metals are heated together up to the melting point of tin in the proportion 2 of tin to 1 of nickel (NiSn) a homogeneous melt is obtained with great evolution of heat.

L. Guillet † has determined the equilibrium diagram and promises a detailed account. Four solid solutions and one compound NiSn are formed. Two of the solutions (α and α' containing 0–5 p.c. tin) are identical in composition, but differ in that one is magnetic, the other not. The β solid solution contains 38–41 p.c., the γ, 55–60 p.c. tin.

ARRIVAUT, G.—**Alloys of Manganese and Molybdenum.** *Proc. Soc. des Sci. Phys. et Nat. de Bordeaux*, 1905–6, pp. 7–10.

„ „ **Alloys of Manganese with Nickel and Cobalt.** *Tom. cit.*, pp. 107–14.

„ „ **Alloys of Manganese and Vanadium.** *Tom. cit.*, pp. 152–4.

HAILSTONE, G.—**The Characteristics of Foundry Iron.**
[Contains a section describing the micro-structure of cast iron.] *Foundry*, xxx. (1907) pp. 20–30 (17 figs.).

HUDSON, O. F.—**Microscopic Testing of Cast Iron.** *Tom. cit.*, pp. 132–4.

PETRENKO, G. J.—**Alloys of Silver with Lead and Tin.** *Zeitschr. Anorg. Chem.*, liii. (1907) pp. 200–11 (21 figs.).

„ „ **Alloys of Silver with Iron, Nickel, and Cobalt.** *Tom. cit.*, pp. 212–15 (1 fig.).

RUER, R.—**Alloys of Palladium and Lead.** *Zeitschr. Anorg. Chem.*, lii. (1907) pp. 345–57 (14 figs.).

SAUVEUR, A.—**Metallography applied to Foundry Work.** *Foundry*, xxx. (1907) pp. 79–82 (8 figs.).

„ „ **The Structure of Wrought Iron.** *Electrochem. and Met. Ind.*, v. (1907) pp. 119–20.

VIGOUROUX, E.—**Alloys of Iron and Molybdenum.** *Proc. Soc. des Sci. Phys. et Nat. de Bordeaux*, (1905–6) pp. 2–6, and 67–70.

„ „ **Alloys of Iron with Nickel and Cobalt.** *Tom. cit.*, pp. 96–8.

The Evaporation of Solid Metals and their Compounds. *English Mechanic*, lxxxv. (1907) p. 251.

Melting Points of Elements.
[J. A. Harker's table of melting points is given.] *Electrochem. and Met. Ind.*, v. (1907) p. 48.

Nitrogen in Iron. *Tom. cit.*, pp. 51–2.

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* Comptes Rendus, cxliv. (1907) pp. 689–41 and 712–14.
† Tom. cit., pp. 752–3.

MEETING

HELD ON THE 17TH OF APRIL, 1907, AT 20 HANOVER SQUARE, W. G. C. KAROP, ESQ., M.R.C.S., IN THE CHAIR.

The Minutes of the Meeting of the 20th of March, 1907, were read and confirmed, and were signed by the Chairman.

Mr. Barnard exhibited and described the advantages of the Mercury Vapour Lamp, used as an illuminant in connection with the Microscope.

Mr. F. W. Watson Baker, on behalf of Messrs. Watson and Sons, exhibited a new form of expanding stop, for use with a substage condenser, to enable a dark ground to be produced with objectives of different apertures. It was made to fit into the carrier of an ordinary Abbe illuminator.

The Chairman thought this a most ingenious device, which was likely to be of great value to any one who wanted to use stops of different sizes.

Mr. A. Earland—who had arranged an exhibition of slides of Foraminifera—said that while on a former occasion he had exhibited specimens selected for their beauty only, he had this time endeavoured to combine elegance of form with other points of interest. He then proceeded to describe the exhibits, which consisted entirely of typical "arenaceous" Foraminifera, and were arranged in a series intended to show the varying degree of skill and "selective power" exercised by the animal in the construction of its test or shell.

On the motion of the Chairman, votes of thanks were passed to Mr. Barnard and Messrs. Watson for their exhibits, to Mr. Earland for his very interesting and instructive remarks upon the exhibition he had arranged; also to Messrs. C. Baker for having provided the Microscopes under which Mr. Earland's slides of Foraminifera had been shown.

Mr. E. M. Nelson's paper, "On the *Podura* Scale," was read by Dr. Hebb—copies of the figures in illustration being drawn on an enlarged scale upon the board by Mr. Scourfield.

The Chairman thought it was very refreshing to hear a paper on an old subject like that of the *Podura* scale, which, however, did not appear yet to have been worked out fully.

Mr. Conrady thought that Mr. Nelson was under a mistake as to the cause of the effect produced by looking at an object in contact with the cover-glass, because the scales were in this case not in actual contact with it, but there was a very thin layer of air between, which allowed the light to pass through—which was known as Stokes' layer. Also in his

remarks as to polarisation, the passage of light through a tiny aperture caused it to be diffracted, and diffracted light was polarised.

Mr. J. W. Gordon said with regard to total blackness, this was not a question of Stokes' layer, but was certainly due to something which had intervened between the cover-glass and the specimen (in illustration of which a diagram was drawn on the board). If it were a mere question of Stokes' layer, reflection would occur from the back of the specimen, which in that case would be uncovered. To produce the total blackness described by Mr. Nelson, the homogeneous medium must fill the entire space between the cover-glass and the slip. Stokes' layer, therefore, could not afford any explanation whatever. With regard to Mr. Conrady's second hypothesis, he did not understand Mr. Nelson to say that the light was polarised, but that it was depolarised. He (Mr. Gordon) was not aware that diffracted light was polarised when diffracted by a transparent diffractor as distinguished from a reflector, but in any case it seemed impossible that a mere aperture should serve as a depolarising agent.*

On the motion of the Chairman, a vote of thanks to Mr. Nelson for his paper was unanimously passed.

A paper by Dr. Antonio Rodella, "On the Root Bacteria of Pulse," was read by Dr. Hebb, and the thanks of the Meeting were voted to the author.

Dr. Ettles exhibited and described the Ettles-Curties Ophthalmometer and a Corneal Microscope.

A demonstration of the application of the instrument was given at the close of the Meeting, upon a patient with pronounced astigmatic vision, who presented himself for the purpose of the experiment.

The thanks of the Society were unanimously voted to Dr. Ettles for exhibiting the instrument, and for his subsequent demonstration of its action.

It was announced that at the next Meeting of the Society (on May 15) there would be an exhibition of Pond-life.

The following Instruments, Objects, etc., were exhibited:—

Mr. J. E. Barnard:—Illumination by means of a Mercury Vapour Electric Lamp, and different colour screens, under three Microscopes.

Mr. A. Earland:—Exhibition of slides of Arenaceous Foraminifera, as follows:—

1. Arenaceous Foraminifera from various parts, and from shore sands to 2500 fathoms. Selected to show the great variety of materials used

* Mr. Gordon desires to add that since the Meeting he has examined with a Nicol's prism both the spectrum of a transparent grating and the diffracted light from a *Podura* scale. In neither case could he find any visible trace of polarised light. He suggests that Mr. Conrady may have been misled by observing the polarisation which probably does occur in the reflected spectra from a metallic grating.

in the construction of the composite shell or test, and the different degrees of neatness in construction, which varies with the amount of cement used.

2. *Astrorhiza limicola*, from Lervik Fjord, Faroë Islands, about 130 fathoms. Test built up of mud and sand-grains of uneven size. Very brittle; practically no cement used. The sarcode streams from the open ends of the arms, which are often very long.

3. *Astrorhiza arenaria*, from Lervik Fjord, Faroë Islands, about 130 fathoms. Test built up of fine sand-grains of equal size, and without visible cement. It is very friable. There is a loosely-built termination to each arm, through which the sarcode streams; it also exudes between the sand-grains. Dried-up pseudopodia can be seen on one specimen.

4. *Crithionina pisum*, from the Faroë Channel, 555 fathoms. Test built up of very minute sand-grains, without visible cement. Very friable. There is no aperture; the protoplasm streams between the sand grains of the test.

5. *Crithionina pisum* var. *hispida*, off Florida, 509 fathoms. Test built of fine sand, with sponge-spicules incorporated. The sponge-spicules are set projecting vertically from the surface, instead of being built in, as is usually the case. No aperture; the protoplasm exudes between the grains.

6. *Haliphysema Tumanowiczii*, attached to zoophyte, from Pegwell Bay, Kent. The test is built up of fine sand-grains, broken spicules, and cement. The terminal brush of sponge-spicules possibly serves to protect the animal from molluscs. It was originally described by Bowerbank as a sponge. Its foraminiferal nature was demonstrated by Carter.

7. *Psammosphæra fusca*. Four specimens from North Atlantic, 1525 fathoms, the others from the North Sea, 130 metres. Test, a rough sphere of sand-grains, cemented together without visible aperture. Sarcode exudes through interstices and through cement. No selective power shown in the choice of sand-grains, which are always of unequal size. When sand-grains are not available, the shells of other forams are used, as in the group from 1525 fathoms.

8. *Psammosphæra fusca* var., off Culebra Islands, West Indies, 390 fathoms. Test, a simple sphere of coarse sand-grains built round a sponge-spicule. The object of the spicule is probably to increase the area of resistance, and so diminish the chance of sinking into the ooze.

9. *Saccammina sphærica*, from the North Sea, 135 metres, and North Atlantic, 555–1060 fathoms. Test built very neatly of small sand-grains, with much cement. Smoothly finished externally, rough inside. There is generally a short tubular neck, with aperture, but this is absent in the highly-finished central specimens, one of which is laid open. When there is no aperture, the sarcode exudes between the grains.

10. *Webbina clavata*. A common deep-sea foram, found all over the world, principally in about 500 fathoms. As the depth increases, the size of the chamber decreases in proportion to the tube, as shown in group from 1300 fathoms, where the specimens are growing attached to other species, and the chamber has dwindled down to a small bulb. There is no "floor" to the attached chamber or tube. Test built up

of very fine sand, with a large quantity of cement. One of the simplest types of shell structure, consisting only of a hemispherical chamber opening into a tube, which may grow indefinitely.

11. *Ammodiscus incertus*, from North Atlantic, off Spain, 1000 fathoms. Distribution world-wide, from the shore line to 3125 fathoms. It ranges back at least as far as the Carboniferous period. In the specimens shown the test was composed almost entirely of cement, no sand-grains being visible. One of the simplest types of shell structure —a simple tube without internal divisions, and coiled in a plane.

12. *Reophax scorpiurus*. Timor, near Java, 50 fathoms, from coral mud; North Sea, various depths, from sandy mud; North Atlantic, 1525 fathoms, from *Globigerina* ooze. The material on the spot is generally used for the construction of the shells of arenaceous Foraminifera. The external appearance of the same species may therefore vary greatly according to the nature of their surroundings. No sand being procurable, the specimens from the North Atlantic have used other Foraminifera. Those from shallow water in the North Sea have used sand-grains of various sizes. Garnets were collected by one specimen.

13. *Marsipella elongata*, from North Atlantic, 664 fathoms, and *M. cylindrica*, from North Sea, 361 metres. Tests built of sponge-spicules mixed with sand-grains; in one specimen the spicules are arranged with a spiral twist.

14. *Technitella melo*. The largest specimen is from the Caribbean Sea, 382 fathoms; three small tests from Timor Sea, Java, 50 fathoms; the specimen with tripod spines at the base, from Cebu, Philippine Islands, 120 fathoms. The three spines may be intended to keep the test with the aperture uppermost in the soft mud. A very high degree of selective power shown in the collection and arrangement of material for the test, which is a hollow flask with terminal aperture, built up of sponge-spicules neatly cemented together.

15. *Technitella melo*, from the North Sea, 361 metres. The test is not of the usual shape (an oval flask), but a short cylinder, and the animal has shown great ingenuity in closing up the two ends of the cylinder. The usual aperture is not present.

16. New and undescribed foram, from Cebu, Philippine Islands, 120 fathoms. Selective power exhibited in the building up of the test of sponge-spicules, which are arranged in regular rows with cement between.

17. Fragments of unknown organism (possibly an undescribed foram) from the North Atlantic, 664 fathoms. The entire shell is probably a tube in shape. Selective power in a marked degree. Shell built of broken sponge-spicules, which are cemented together somewhat in the manner known in architecture as "Flemish bond," so as to give strength to the shell.

18. *Carterina spiculotesta*. Large specimen from Timor Sea, Java, 50 fathoms. Small specimen from shore sand, Palermo, Sicily. Very rare, but widely distributed in warm seas. Specimens are generally found adherent to coral or shells, not growing free as in specimens exhibited. The shell is built up of small calcareous fusiform spicules, secreted by the animal itself. The spicules are joined together with

calcareous or chitinous cement. This is the only foram that secretes a spicule.

19. *Globigerina bulloides*, and its isomorph, *Haplophragmium globigeriniforme*, from Indian Ocean, 1300 fathoms. Isomorphism between an arenaceous and a hyaline species.

20. Triple Isomorphism. Imperforate or porcellaneous type, *Cornuspira*; arenaceous type, *Ammodiscus*; perforate or hyaline type, *Spirillina.*

21. Foraminifera illustrating the three chief divisions: Imperforate or porcellanous; arenaceous; perforate or hyaline. Various localities.

Dr. Wm. Ettles:—Ophthalmometer and Corneal Microscope.

Messrs. W. Watson and Sons:—Expanding Stop for use with a condenser, for dark ground illumination.

New Fellow.—Mr. F. R. T. Lucas was balloted for and elected a Fellow of the Society.

MEETING

HELD ON THE 15TH OF MAY, 1907, AT 20 HANOVER SQUARE, W., THE RIGHT HON. LORD AVEBURY, F.R.S., ETC., PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 17th of April, 1907, were read and confirmed, and were signed by the President.

The List of Donations to the Society since the last Meeting (exclusive of exchanges and reprints) was read, and the thanks of the Society were voted to the donors:

	From
Matthews, J. Merritt.—The Textile Fibres. Their Physical, Microscopical and Chemical Properties (8vo, New York and London, 1907)	*The Publishers.*
A Traviss Expanding Stop for Dark-ground Illumination	*Mr. H. Ausbuttel.*

Professor Alfred W. Porter read a paper by himself and Mr. P. F. Everitt on "Diffraction Rings due to a Circular Aperture," in which he stated that he considered the differences mentioned in Mr. Nelson's paper—read on the 21st of March, 1906, and printed in the Society's Journal for October, 1906—between the theoretical and the observed radius of the first dark diffraction ring, must be due to the method of observation, because the values obtained from a very complete series of observations made for him by Mr. P. F. Everitt under the best conditions were in very close agreement with theory.

Mr. J. W. Gordon said it was a little difficult to follow a paper such

as they had just heard unless it could be seen in full and in print, but he understood that the artificial star employed for the purpose of the demonstration had been formed by passing light through a small hole in a diaphragm. The diameter of the ring was therefore not the image of a mathematical point of light such as a star, the diffraction fringe being formed about a small surface, the geometrical image of the hole, and it looked to him as if the aperture of the hole described by Professor Porter had an angular measurement of about 2½ seconds of arc. In order to reduce the value of this to that of theory, it would be necessary to deduct from the observed ring the value of this geometrical image in order to get the reduced diameter. He hoped, therefore, that when the paper was printed Professor Porter would give them the material from which the angular value of the ring could be determined, because he did not gather in listening to the paper that the figures put before them comprised the necessary data. He was sure that when they could read the paper in its complete form the Fellows would feel greatly indebted to Professor Porter for bringing this interesting subject before the Society.

Mr. Conrady said he had listened to the paper with great interest, for he had been hoping that some reply would be made to the statement of Mr. Nelson which had been referred to, since he rather thought Mr. Nelson had got a little mixed up over the great variation in the rings which took place as the telescope was racked out. He understood that Mr. Nelson dealt with the results obtained with an ordinary object-glass, whilst the theory implied that an absolutely spherically correct object glass was used, and this was not yet produced by anyone, as the best corrected object-glass always gave a slight amount of spherical aberration, causing a slight distortion. The cause of a distorted wave had been brought to a theory by Dr. Stoffer, of Jena. He believed, therefore, that what happened in Mr. Nelson's case was that he had used an objective with a slight spherical aberration. He thought that Professor Porter, in arranging his experiment, had done a wise thing, and one which was more likely to give greater accuracy. He was sure that Professor Porter had given them a very interesting and useful paper, and for his own part he would rather back his figures than those which had been given to them before.

Mr. Beck said that the point which struck him in Mr. Conrady's suggestion was that it was difficult to see how aberration or focusing could reduce the size of the rings, though it was easy to see how it might increase it.

Professor Porter, in reply, said that he would take care to give in his paper the full details from which they would be able to calculate the angular aperture of the point of light, which was, as a matter of fact, about 80 ft. distant. He might say that in arranging the experiment this matter had not been overlooked, and that the pin-hole chosen was sufficiently small to render negligible the error arising from its size. He did not care to guess what happened to Mr. Nelson, but he felt sure that Mr. Nelson, as well as himself, had used a diaphragm placed in front of the telescope, and he had written to him about the subject because he had thought there was a possible explanation to be made as to the cause of the discrepancy ; this, however, he now thought was not

the case. As regarded the influence of spherical aberration, the actual diameter of the ring would not at first be rapidly disturbed, and the imperfection of the instrument employed would have to be considerable before its influence would become sensible, and he knew that Mr. Nelson had used a variety of objectives and telescopes, many of which were of the best quality, so he did not think that the source of error would be found in this direction.

Mr. Nelson's paper "On an Improved Vertical Illuminator" was read by Dr. Hebb.

The President said it was rather early in the evening to complete the reading of the papers, but there were so many interesting objects in connection with "Pond Life" arranged for their inspection, that he was sure they would be glad to have ample time for the examination of the beautiful objects which had been brought for their inspection. He was sure they were much obliged to the exhibitors.

Votes of thanks were unanimously passed to Professor Porter and Mr. Nelson for their papers, and to those Fellows of the Society and Members of the Quekett Microscopical Club who had brought objects for exhibition to the Meeting.

Notice was given that at the close of the ordinary business of the next Meeting on June 19, the Meeting would be made special for the consideration of a proposed alteration in Bye-law No. 65a. It was also announced that at the next Meeting a lecture would be given by Mr. F. Enock, with lantern illustrations.

The following Instruments, Objects, etc., were exhibited :—

The Society :—A Traviss Expanding Stop for dark-ground illumination. *Membranipora monostachys* var. *fossaria*, a brackish water Bryozoon from Great Yarmouth, from Mr. H. E. Harrell. *Melicerta ringens* and *Volvox globator* from Mr. John Hood.

Mr. F. W. Watson Baker :—*Plumatella repens.*
„ T. N. Cox :—Spirogyra.
„ R. E. Crossland :—Vorticellæ.
„ T. A. Delcomyn :—Desmids.
„ J. Dick :—Marine organisms.
„ A. Downs :—*Hydra viridis* and *Volvox globator.*
„ F. Enock :—12 eggs of a Hemipteron (plant bug). Each egg containing from 4 to 6 Ovivorous Parasites.
„ T. D. Ersser :—Water mite.
„ W. Gardner :—*Cristatella mucedo.*
„ A. E. Hilton :—Cyclosis in leaf of water thyme (*Elodea canadensis*).
„ E. Hinton :—*Lophopus crystallinus.*
„ J. T. Holder :—*Stephanoceros Eichhorni.*
„ T. G. Kingsford :—Conjugation of Spirogyra.

Mr. K. I. Marks :—*Asplanchna* sp., *Brachionus angularis*, *Dinocharis pocillum*, *Philodina* sp., *Rotifer vulgaris*, *Stephanoceros Eichhorni*, Cypris, Stentors.
„ H. S. Martin :—*Lophopus crystallinus*.
„ J. M. Offord :—*Volvox globator* with parasitic rotifer, *Proales parasita*.
„ J. I. Pegg :—Crustacea.
„ J. H. Pledge :—*Macrobiotus*, showing pharynx, fat corpuscles, etc.
„ T. H. Powell :—Cyclosis in *Vallisneria* with $\frac{1}{12}$ in. dry apochromatic.
„ G. H. J. Rogers :—*Volvox globator*.
„ C. F. Rousselet :—*Floscularia ornata*, *Notops brachionus*, *Triarthra longiseta*, *Volvox globator*, aureus stage, *Lophopus crystallinus*.
„ D. J. Scourfield :—*Macrobiotus*, cast skin with eggs.
„ C. J. H. Sidwell :—*Macrobiotus*, × 400.
„ T. J. Smith :—*Diaptomus castor*.
„ C. D. Soar :—Water mites.
„ W. B. Stokes :—*Floscularia ornata*.
„ H. Taverner :—Water mites.
„ W. H. Traviss :—*Daphnia vetula*.
„ J. C. Webb :—*Melicerta ringens*.

New Fellows.—The following were elected *Ordinary* Fellows of the Society :—Messrs. Richard Douglas Bailey, Francis Davidson, Dr. Hans Harting, Messrs. J. W. Ogilvy, and Geoffrey Sydney Williams.

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Journal of the Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(Principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

EDITED BY

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WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

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FELLOWS OF THE SOCIETY

AND

A. B. RENDLE, M.A. D.Sc. F.L.S., *Keeper, Department of Botany, British Museum*

HAROLD MOORE, B.Sc., *Woolwich Arsenal*

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quas qui fugit pariter Naturam fugit.—*Linnæus.*

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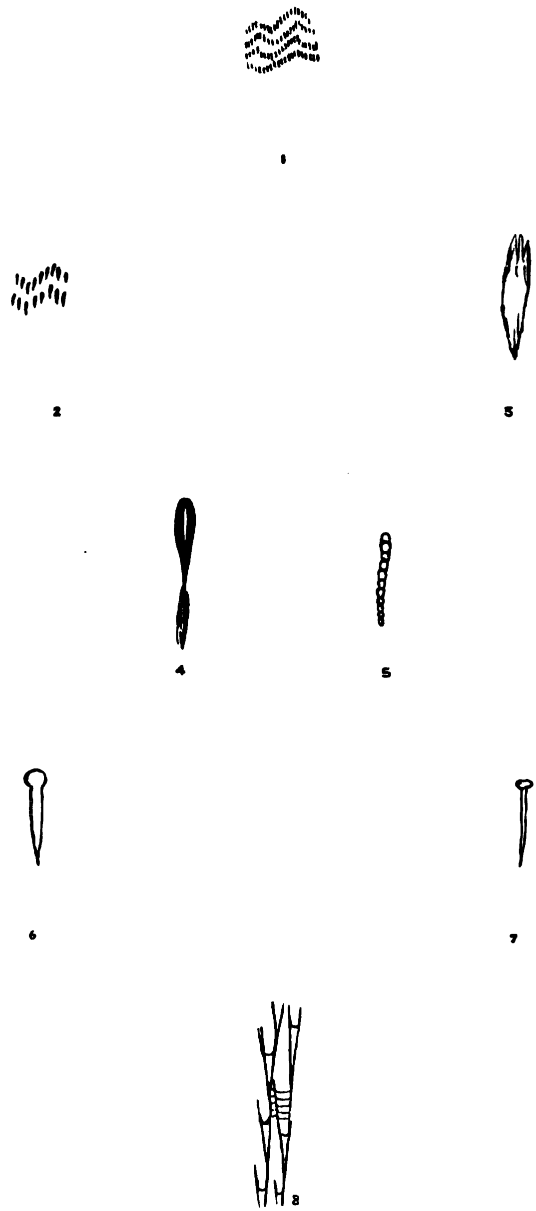
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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

AUGUST, 1907.

TRANSACTIONS OF THE SOCIETY.

X.—*On the Podura Scale.*

By Edward M. Nelson.

Plate XVI.

(Read April 17, 1907.)

This is a subject interesting to microscopists only. Almost every other object that can be examined with a Microscope appeals to workers in other branches of science, such as zoologists, biologists, histologists, botanists, geologists, chemists, etc. Even lines ruled upon glass claim some attention from the physicist, but the exclamation marks on the *Podura* scale are a veritable *bête noire* to every one except a microscopist.

It is strange, but true, that while the *Podura* scale has been the most looked-at object of any, it still remains the microscopist's enigma, and this, moreover, in spite of the fact that its structure is by no means so very minute for a microscopical object.

This year this test becomes an octogenarian, for we learn from Dr. Goring that the *Podura* test was not known when he read his

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EXPLANATION OF PLATE XVI.

Fig. 1.—Watered Silk. T. Carpenter. 1827.
„ 2.—Wedge-shaped Spines. Dr. Goring. 1830.
„ 3.—Featherlets. John Quekett. On the Microscope, 1848, pl. 6, fig. 4*a*.
„ 4.—Indian Clubs. R. Beck. The Achromatic Microscope, 1865, pl. 7, fig. 1.
„ 5.—Beads. Dr. Pigott. M.M.J., ii. (1869) pl. 33, fig. e.
„ 6.—Knobbed Heads. F. H. Wenham. M.M.J., iv. (1870) p. 125.
„ 7.—Pins. T. F. Smith. J.R.M.S., 1888, p. 499.
„ 8.—Cuneiform. E. M. Nelson. 1907.

paper, "On Tulley's Thick Aplanatic Object-glass," before the Royal Institution * in 1826. Dr. Wollaston states, in 1828, that with his microscopic doublet he had seen the finest striæ and serratures upon the scales of the *Lepisma* and *Podura*. It appears, then, that the *Podura* test was known in 1828, and unknown in 1826, therefore its discovery may well be assigned to the year 1827.

Pritchard tells us that the *Podura* test was discovered "by the late Thomas Carpenter, Esq., of Tottenham, while making some experiments with a plano-convex jewel lens, employed as the objective of an Engiscope, having an Huyghenian eye-piece."

Dr. Brewster, in 1830, states that the lines on the scales of *Podura* spring-tail are the most difficult of all the test objects.

E. J. Quekett, in 1843, says that the most delicate and closest markings on the scale of *Podura* ($\frac{1}{40000}$ in. asunder) may be magnified to 1100 diameters, and still be perfectly defined by Mr. Ross' new $\frac{1}{8}$ of 80° aperture. His brother, John Quekett, states that at the time of the publication of Pritchard's "Microscopic Cabinet" (1832) nothing but longitudinal and oblique lines could be made out, but that now (1848), with a power of 1250 diameters, the scales may be seen to stand out boldly from the surface. At the upper part of the scale they also project beyond the edge.

Before proceeding, it may be of interest to state that old non-achromatic Microscopes of good construction fail to show the exclamation marks, which can, however, be just glimpsed with a Wollaston doublet, and also with a Lister-Tulley achromatic Microscope—the doublet giving the better image.

It is not easy to understand what Quekett means by "longitudinal and oblique lines," for the unresolved appearance of a *Podura* scale is like "watered silk." If any one wants to know what the best Microscopes of 1830 were capable of showing, let them place a Zeiss *a a*, or a Leitz No. 2, on the nose-piece, and a strongly marked *Podura* scale on the stage, and they will see the "watered silk" just breaking up into exclamation marks (23,000 per inch), which is all, or perhaps a trifle more than could be accomplished in 1830. During the next ten years great improvements were made in the construction of achromatic objectives by Mr. Lister, who coached both Andrew Ross and J. Smith, and through them Hugh Powell. An inch of Powell's of 1840 shows the exclamation marks better than any old lens of that power, and, by reason of its slightly larger aperture, better than the two semi-apochromats mentioned above.

This description and plate of John Quekett's did duty for some fourteen years, until Richard Beck's paper and excellent drawings

* Journ. Roy. Inst., xxii. ser. 1 (1827) p. 265.

appeared in our Transactions in 1862.* He delivered it as his opinion that the exclamation marks were upon one surface of the scale, and that they were caused by the saw-edged nature of longitudinal ribs. The next stage was the announcement, in 1869, by Dr. Pigott that the accepted images of the exclamation marks were quite fallacious, and that they really consisted of rows of beads like "peas in a pod."

This started a long controversy; some (Reade, Maddox) agreed with Pigott, others (Wenham) with Beck.

Woodward at first sides with Pigott, but subsequently adopts Beck's view, while McIntire does the reverse.

Dr. Pigott describes the methods of illumination by which these beads were produced. They were three in number, but it will be sufficient for our purpose if we examine only one of them, as the others were merely varieties of the same idea. Powell's achromatic condenser had a cap with a minute hole in it for centring purposes; Pigott used this with the cap on! By this means an illuminating cone of the smallest dimensions is produced, and bright diffraction spectra are formed at the periphery of the objective. The objective is placed out of adjustment, so that these peripheral rays are combined at a focus differing from those at the centre, consequently the image of the structure is a quadruple of the original; for in the case of a *Podura* scale the spectra at the periphery of the objectives they used would be of the second order; (four times 23,000 is 92,000, which is just right for the water-immersions, which had then been recently introduced, and which were from 1·1 to 1·2 N.A.). For the purpose of placing the lens more completely out of adjustment, Pigott inserted in his Microscope tube an inner tube, containing two converging lenses; this he called an aplanatic searcher, but it was merely a copy of the erecting tube in the Lister-Tulley Microscope.†

In 1872 Dr. Arnold dries the scales in a chemical oven, and blows off the exclamation marks with an electric spark. In 1876 Dr. Woodward shows that false beading can be produced upon gnats' scales by diffraction fringes thrown off from the ribs under oblique illumination.

In spite of this cogent argument, Pigott still maintains his bead theory, and says ‡ regarding the illumination: "General opinion seems gradually to have come round in favour of pin-hole stops

* T.M.S., x. (1862) pl. x. (pl. ix. is a misprint) fig. 1. This is an excellent drawing by R. Beck, which should be compared with his later drawing (1865) in "The Achromatic Microscope," pl. 7, fig. 1. Beck had then formed the opinion that the exclamation marks were saw-edges on the longitudinal ribs, and he illustrated this idea in his figures. In the large figure on the frontispiece, amplified 1300 diameters, the exclamation marks run in straight rows of vertical lines, which is hardly true to nature; this figure should be compared with Piffard's and O'Donohoe's photomicrographs, J.R.M.S., 1893, p. 789, and 1906, p. 156.

† See this Journal, 1900, p. 550. ‡ M.M.J., xvi. (1876) p. 186.

for distinct definition; the effect of which is to limit the illuminating rays, and prevent the object being drowned in excess of light. A pin-hole stop limits the illuminating pencil to perhaps ten degrees. . . . A Beck iris diaphragm attached below this kind of condenser ($1\frac{1}{2}$-in. objective of ten degrees) gives every degree of fineness required in the illuminating pencil. Great advantage is also sometimes obtained by stopping off half the rays."

Next, in 1877, Dr. Edmunds experiments with scales mounted upon the slip, illuminating them by an immersion paraboloid (a device of Wenham's) and finds that the exclamation marks are featherlets. He measures one $\frac{1}{5000}$ in. long, and $\frac{1}{20000}$ in. wide (this measurement of the width is more than 100 p.c. too large).* We are thus brought back to the resolution of John Quekett's time.

In 1882 Stodder and Hitchcock find that the exclamation marks are not spines, and in the following year Moore and Hitchcock find that they are spines.

In 1888 T. F. Smith proposed a new image with a large axial cone, and white dot focus; he says that the exclamation marks are precisely like pins, and that with this illumination the surface of the scale between the exclamation marks exhibits structure; oblique lines can be seen springing from the head of a pin and running to the points of the pins just above them on either side.

In 1892 Dr. Mercer says that the exclamation marks are not spines, but corrugations; but Vereker and Wright regard featherlets as the correct image.

In 1895 Letherby says that the exclamation marks are perforations, and in 1906 Dr. Stokes writes confirming Letherby's view of the subject.

This necessarily brief history of the *Podura* test is now brought down from the time of its discovery to the present day. The literature on the subject is large, and not readily accessible, because many important observations appear indexed under the name of some condenser, or other piece of apparatus, and therefore elude search. A bibliography is annexed, which may probably be found useful. Papers on the structure of scales other than those of *Podura* are included in the list, as a good deal may be learnt from analogy. This history amply justifies the statement that the *Podura* scale is the microscopist's enigma, for it proves that microscopists, who have for eighty years patiently studied the scale, are nevertheless not agreed as to its structure.

Before concluding, I ask for a little space for some observations of my own; but first we must weigh the respective merits of the

* This measurement, which was no doubt correctly performed, is of much interest, as the object was measured with dark-ground illumination, and no allowance made for antipoint; this should be compared with the uncorrected measurement of $\frac{1}{52400}$ on a bright ground (*infra*). The mean of the two uncorrected images is $\frac{1}{36200}$ in., while the corrected measurement is $\frac{1}{30500}$ in.

views of the eminent microscopists just given. Pigott's beads must, for reasons stated above, be ruled to be quite out of court. But what about featherlets? They have been seen by J. Quekett, Edmunds, Moore, Morehouse, Hitchcock, Vereker, and Wright. The objections to featherlets are: 1. No one has observed a missing featherlet. 2. They seldom protrude beyond the margin of a fracture; but very often half an exclamation mark may be seen on one side of a fracture and half on the other. This has been well shown by Dr. Mercer (see his photograph). Personally, I have neither seen nor experimented with Dr. Arnold's electric spark, but notwithstanding, the weight of evidence seems to be overwhelmingly against featherlets.

The latest suggestion is that of Letherby that they are apertures. One very weighty objection to this view of the question is that the exclamation marks de-polarise light; for if the scale be rotated in a dark polarised field the exclamation marks become brilliantly illuminated when a particular azimuth is reached. This was exhibited before the Society many years ago. There is another, and very important point, where, if I read Mr. Letherby's paper correctly, he seems to have got quite off the track. Several very eminent microscopists, who have devoted a great deal of time to the *Podura* scale, are agreed that these scales contain a kind of fluid (oil?), and it is common knowledge that these scales stick to the cover-glass by virtue of this fluid, and no mounter, however expert, is able, when once they have adhered to a cover-glass, to remove and remount them. This fluid can be seen in figs. 3 and 6 of Mr. Letherby's photographs; but Mr. Letherby, who has photographed this object so well, gives a totally different explanation of the phenomenon. He says that this is not fluid, but the abrasion and absence of the upper membrane. It is upon this point then that we will join issue; but a digression is necessary to remind any who may have forgotten it, that a vertical illuminator (in spite of its absurd name) is an instrument for making an objective illuminate its own object, and that its action depends upon the principle that light passing out of the front lens, through the oil and into the cover-glass, at an angle greater than the critical angle, is totally reflected from the lower side of the cover-glass.

Three results follow in consequence: (1) an object not in optical contact with the lower side of the cover-glass is invisible; (2) the object, when seen, is seen in the image of the source of light, and, when the object is removed, the image of the source of light remains; (3) any object which appears black or dark does so because it touches the lower side of the cover-glass and allows the light, which otherwise would be totally reflected, to escape.

Now, if a *Podura* scale be examined with the vertical illuminator, what do we see? (1) The exclamation marks are black. (2) Those portions where the fluid has run in are inky black.

If the exclamation marks are holes there would be nothing at those points to touch the lower side of the cover, and consequently, the light would be totally reflected, and the image must be bright. Again, if those parts where the fluid has run in are, as Mr. Letherby suggests, portions where the upper surface of the scale has been abraded, then the image cannot be black. The inky blackness which is seen can only be caused by the fluid neutralising the total reflection at the lower surface of the cover-glass. The authors of the Micrographic Dictionary say "the scales often become partially or entirely covered with the oily matter, producing an appearance as if the upper layer of the scale were removed, and rendering the markings so pale and indistinct, as to be apparently absent." Mr. R. Beck says that "the markings almost entirely vanish when the irregularities of the surface are removed by the presence of moisture. Fig. 3 represents this appearance on the *Podura* scale; and I cannot but think that Dr. Carpenter is mistaken when he says that such scales have lost a portion of their superficial layer by some accidental injury."

In the face, then, of these facts, the perforation theory cannot be maintained. [In this connection there is one important point of great interest to the brass and glass section of microscopists which, so far as I am aware, has hitherto escaped notice. The "Black Dot" of the vertical illuminator is the "White Dot" of transmitted light, and both are precisely at the same focus. The "White Dot" of the vertical illuminator is below the "Black Dot," and so illumination by the vertical illuminator may be said to be reciprocal to that by transmitted light.]

Mr. R. Beck in 1862 examined the scales, when mounted on the slip without cover, by reflected light, and gives an interesting account with figures of the experiment. He states that "when the markings are at right angles to the direction of the light, the side farthest off is illuminated; when they lie in the same direction as the light, with their narrow ends pointing to it, the broad ends appear like brilliant spots, but when this direction is reversed, the light from the points is so slight that the scales appear to have lost their markings altogether. Now, if the object were an opaque substance, this result would have been a convincing proof that the markings were depressions; but as we know it to be transparent, it follows that these particular appearances can only be produced by elevations."

With this I entirely agree. Let me urge every microscopist to examine this experiment for himself. Take a wide-angled oil-immersion condenser (Powell's truncated does very well) and any dry objective from N.A. 0·45 upwards will do. The scale must be on the slip, but in almost every slide a few scales will be found on the slip. Focus the edge of the flame sharply on the scale, and turn on the slot so that the scale may be strongly illuminated on a

dark ground. Now when this illumination is in a direction from the root to the tip a most striking image is obtained; the tops of the exclamation marks shine out like bright stars on the dark ground of the scale. If the objective is a good one, and in correct adjustment, these stars shine out clear and sharp, without any flare or haziness of any kind. They are precisely like the electric lamps which spell out the advertisements from the tops of tall buildings in London. When the stage is rotated so that the light falls on the scale in the reverse direction, viz. from tip to root, the image is entirely changed, the electric lamps now shine with a dim light, just as if something had gone wrong, either with the current or with the switch. Mr. Beck's figure shows a little speck of light at the point of the exclamation mark, but actually it is in the same place as it was before, viz. at the head. When the scale is illuminated at right angles to its length it appears very bright, the whole of the exclamation mark being illuminated. It should be noted, however, that this illumination, by means of an oil-immersion condenser, is very much more powerful than any method known in Beck's time; consequently, the phenomena are more easily observed.*

Those wishing to pursue this subject, should read the excellent papers by Messrs. Beck, McIntire, Smith, and Wenham: the references to these will be found in the attached bibliography. The postage-stamp fracture appearance, which is obtained with the vertical illuminator, is probably due to the oil or moisture running in between the tops of the exclamation marks and the lower side of the cover-glass; we must always remember in interpreting this kind of image that we are not dealing with a fracture, but with structure which, though present, is obliterated by moisture.

An examination of a *Podura* scale in a critical manner with modern apochromatic objectives, illuminated by a full axial cone from an achromatic oil-immersion condenser, shows that the exclamation marks have V-shaped heads, causing them to assume the appearance of the cuneiform marks on the Assyrian inscriptions. Both the pin and knobbed heads of the exclamation marks are due to some obliquity in the illumination, especially in a direction from root to tip. When the full axial cone is perfectly centred the knobbed and pin-shaped heads disappear. The tail of the exclama-

* While working at a *Podura* scale, with this kind of illumination, two of these minute electric lamps were observed close together, shining like a double star when neatly split in a telescope. Objectives of less N.A. were then tried in succession, until one was found that just failed to divide the lamps. This objective had a N.A. of 0·475. The last objective to just split the double had a N.A. of 0·5. An oil-immersion $\frac{1}{12}$ was then placed on the nose-piece, and the distance, from centre to centre, between these two particular exclamation marks, which were leaning towards one another, was measured by a cobweb micrometer, and found to be $\frac{1}{34100}$ in. In the Table of Resolving Limits (this Journal, 1906, p. 529) the limit for N.A. 0·475 is 33,100, and for N.A. 0·5 it is 34,800. So this experiment and the tabular values agree.

tion mark in the next row above springs from one arm of the V at the head of the exclamation mark immediately below, which accounts for the exclamation marks not running in a line, because the tail springs from one of the arms of the V and not from the centre of the head. The "Indian club" shaped exclamation mark, which is the accepted image usually figured, shows, as Mr. Smith has pointed out, that, while the illuminating cone is truly centred, its W.A. is too small. With a large axial cone not a trace of beads, or of "the varicose appearance," can be seen upon the exclamation marks themselves.

Passing now from the exclamation marks to the intervening spaces, a peculiar structure will be found, which for want of a better name, may be called a mycelioid structure, because it looks as if the membrane of the scale had been covered over with a white cobweb form of mycelium. The arms of the V's form the prominent, and readily seen, part of this image. The arm of the V which is not joined to the tail of another exclamation mark runs into a more or less vertical line about the middle of the interspace. Thus far the image is not difficult, but in addition to this there are some minute horizontal filaments of great tenuity joining these vertical lines, the visibility of which, by transmitted light, requires a fine objective, and skilful manipulation.

These horizontal bars are not very close together; they may count as fine as 40,000 to the inch, but the structure is not as regular as the usual tracery in a diatom, the screw micrometer giving measurements varying from 30,000 to 50,000 per inch.

As a rule, there are about five or six bars to the length of one exclamation mark.

When these bars are illuminated by oblique light from a vertical illuminator, they look like beads; these beads are confined solely to the interspaces, and not the slightest appearance of beading can be seen on the exclamation marks. This beading is a false image caused by the oblique illumination of the bars, but the exclamation marks are entities. This is the reverse of Dr. Pigott's view of the subject, for he called the exclamation marks spurious and the beads true structure.

[In an image such as this an apochromat runs away and leaves a semi-apochromat far behind; but in the general run of objects, when a suitable screen is used, there is not much to choose between the pictures rendered by either class of lens, if good.] It will be noticed that this new image of the *Podura* scale is a white dot picture; it has been previously pointed out that when a structure is excessively minute a black dot image is unattainable, so we must be content with what we can get.

In conclusion, it has been seen that these exclamation marks are neither featherlets, nor beads, nor perforations; so much for what they are not: but what are they? They are probably

elevations which adhere closely to the scale for their entire length. Occasionally, at a fracture, one is torn off from one side and left sticking out beyond the edge of the other side, but such a case is by no means common (see photographs, Dr. Mercer's figs. 5, 6 and 7, and Letherby's fig. 7). In Mercer's there are 72, and in Letherby's 44 exclamation marks, either torn asunder, or bent round an edge, and yet not a single spine protrudes clear from the edge; if they were either spines or featherlets it would be difficult to find one not protruding over the edge.

The experiment with polarised light seems to prove that the structure, whatever it is, is considerably thicker at the exclamation marks. Too much stress must not be put on Mr. Smith's contention that the White Dot picture is to be regarded as more correct than the Black Dot image. Black and White Dot images are always complementary, and the Black Dot is not necessarily a small cone image; but Mr. Smith is quite right about the old-fashioned black dot image, which was produced by a small cone. An excellent photograph by Mr. O'Donohoe is seen on pl. 7, p. 156, of this Journal, 1906. The $\frac{2}{3}$ cone used is rather small, nevertheless some of the surface markings between the exclamation marks are visible.

[The question as to whether the Black or White Dot is to be accepted as the correct Microscope image is not yet settled, neither has any satisfactory explanation of the phenomenon been published. A somewhat similar image can be made with a telescope, and at a focus on either side of the star-disk-and-ring image there is an intensely black interference dot. This can be well studied with sunlight and an artificial star. The distance between the two black dots, i.e. the one within and that without the focus, is $\frac{16\,\lambda\,p^2}{a^2}$, where λ is the wave-length, p the conjugate focal length, and a the diameter of the object-glass. Of course, when the object is distant p becomes f the principal focal length.]

A large test scale from a *Podura* measures in inches $\frac{1}{130}$ long and $\frac{1}{580}$ broad, and a large exclamation mark upon it measures $\frac{1}{4900}$ long, and $\frac{1}{52400}$ broad, so roughly speaking, the exclamation marks are just about one wave-length broad, and their length is ten times their breadth. The true measurement of this exclamation mark, correcting for antipoint, is $\frac{1}{4780}$ long, and $\frac{1}{39500}$ broad.

It is common knowledge that the *Podura* scale has played an important part in the perfecting of early achromatic objectives. These objectives are still extant, and for good correction and definition they are even now hard to beat. They were driven out of the market, not on account of their inferior quality, but because of their high price; for example, an old 90° $\frac{1}{4}$ cost five guineas: now a semi-apochromatic one can be purchased for twenty-five shillings.

As a test for dry lenses, from N.A. 0·3 upwards, the *Podura* scale is still unrivalled. Differences between objectives can be detected by a *Podura* scale, which no other test will reveal. It is to be regretted that good test scales have become so rare and difficult to obtain. *Poduras* are quite common, and are, moreover, easily bred. Apart from its utility as a test, it is one of the most beautiful of microscopical objects, whether illuminated by transmitted or polarised light, or seen by dark ground illumination in the manner described above.

As the June No. of this Journal has been published before this paper went to press, there is an opportunity of replying to the criticisms made at the time it was read.

1. If the blackness of the exclamation marks, when the vertical illuminator is used, is due to Stokes' layer, the argument in the paper still remains good, because a Stokes' layer cannot be formed by a hole.

2. If a *Podura* scale is placed between crossed Nicols, the exclamation marks will become brilliantly illuminated, upon a dark ground, at each 90° of rotation.

If the Zeiss-Abbe test-plate is examined in the same manner, the lines are almost invisible, however rotated. A very fortunate accident has happened to one of my Abbe test-plates: a small filament has become entangled in the quicksilver film, and the ruling tool has cut through it, nearly at right angles. Now this filament behaves precisely like the *Podura* scale, for it depolarises the light and becomes brilliantly illuminated at each 90° of rotation, and the contrast between the filament which depolarises the light and the lines which do not is very striking.

A Thorpe's impression grating, and a Grayson's dry-mounted ruling of 15,000 lines to the inch, when rotated in a polarised field, did not depolarise light. Diatoms, when mounted in balsam, give very poor results; the only one in Moller's 400 type-slide to show some illumination was the *Eupodiscus argus*; this remained illuminated at all azimuths, but no black cross was visible. An *Actinocyclus Ralfsii* was very dimly illuminated, and four black dots were noticed at the periphery, which may have been the extremities of a black cross, otherwise invisible.

Diatoms, when dry-mounted, gave far better results. *Pleurosigma formosum* appeared much brighter, and upon rotation exhibited a certain amount of change. *P. angulatum* was still brighter, and exhibited marked changes at each 90° of rotation, passing from a brownish-red to a pale greenish-yellow. *P. balticum*, however, gave the best results, and showed changes very similar to those of *Podura*. An iris-diaphragm was placed at the back of the objective, and all the above phenomena were observed, whether the diffraction spectra were admitted or whether shut out. In order that there might be no mistake about this point, these

experiments were performed with an ordinary 3-in. objective, with its aperture reduced to less than half, and the various appearances detailed above were observed. These experiments prove that the depolarisation of light by a *Podura* scale is not caused by spectra given off by its periodic structure. There appears to be no evidence that rows of holes are capable of depolarising light, and consequently the argument in my paper is sound.

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XI.—*Diffraction Rings due to a Circular Aperture.*

By ALFRED W. PORTER, B.Sc., Fellow and Assistant Professor of Physics, University College, London; and P. F. EVERITT.

(*Read May 15th*, 1907.)

IN a paper by Mr. E. M. Nelson read in March 1906 and printed in the October No. of the Society's Journal, 1906, occurs the following sentence in reference to the diffraction rings formed when light from practically a point source is received after passing through a circular aperture: "If the radius of the first dark ring be experimentally determined, it will be found to be 32 p.c. smaller than its theoretical value. What would be thought of the Newtonian theory of gravitation if the calculated distance of Mars from the Sun was 32 p.c. too great?" This somewhat sweeping criticism of the diffraction theory seemed to call for further experimental tests before it could be accepted, especially as in the early days of the subject experimental verification of the theory was obtained. It is true that Fraunhofer's measurements were made with white light only, and in that respect are imperfect; however, when his values for rectangular and circular apertures are compared, the factor of proportionality between the diameters of the first dark ring in the two cases is found to be exactly 1·22, as required by the theory. These experimental values are conveniently found quoted in Knockenhauer's Undulations-theorie des Lichtes. According to Mr. Nelson, this factor turns out experimentally to be 0·8266. The question is therefore not merely one of disagreement between theory and experiment, but also one of disagreement between Fraunhofer's and Mr. Nelson's experimental values.

The following measurements were made with the object of obtaining a test possessing as great a precision as possible with the modern means at our disposal.

The method adopted was that of direct measurement of the diameters of the rings, using a micrometer eyepiece. An artificial star was set up 23 metres away from a telescopic object-glass of good quality of between 2 and 3 inches aperture giving an image at 670 mm. behind the lens; and diffraction rings of a suitable size were produced by placing a small aperture in front of the telescope. The greatest difficulty was the faintness of the rings when made large. An aperture of 2·23 mm. diameter was found to be the most suitable, and the diameter of the first dark ring was then about 0·2 mm. The artificial star used was a

pinhole 0·3 mm. diameter in a piece of thin brass placed in front of the condenser of an optical lantern, arranged so as to project a parallel beam of light. The angular width of the bright object was therefore only about 4 per cent. of the angular diameter of the first dark ring, and the uncertainty of setting would therefore be considerably less than this. The light was required as nearly as possible monochromatic and very intense for obvious reasons. These results were obtained by using an electric arc, the positive carbon having its core bored out and replaced by finely ground dry salt; this carbon was placed below the negative carbon. This arrangement gives an intense sodium light, consisting mainly of the D-lines, but containing also the other pairs of lines emitted by sodium in the arc. The light from the latter was too feeble to sensibly modify the diffraction figure formed by the much preponderating D light present. The accuracy of the micrometer eyepieces was well within the errors entailed in setting the cross-wire on the rings.

The measured diameters were reduced to give the constant for each ring for comparison with the theoretic values. Of the first dark ring 7 series of 4 measurements were taken; of the first bright ring 2 series of 4 measurements each; and of the second dark ring, 3 series of 4 measurements each. The mean values of these determinations are given below with Airy's values for comparison:—

	Airy.	Present Experiments.
1st dark ring	1·22	1·21
1st bright ring	1·64	1·68
2nd dark ring	2·23	2·20

The outcome of these measurements is to show practical agreement between theory and experiment; this is especially so in the case of the first dark ring, for which the possible precision of measurement is certainly the greatest. The error is greatest in the case of the first bright ring, but here amounts only to 2½ per cent.

OBITUARY.

Siegfried Czapski.

Born, May 28, 1861. Died, June 29, 1907.

By the sudden death of Dr. Siegfried Czapski, at the early age of forty-six, optical science has lost one of its greatest masters, and the Royal Microscopical Society one of its most distinguished Fellows.

Dr. Czapski was born at Obra, in Posen, in 1861, and after a school education at Breslau, he studied physics, mathematics, and chemistry at Göttingen, Berlin, and Breslau, under Helmholtz and Kirchoff amongst others. At the age of twenty-three he took his degree with a thesis on a thermo-electrical subject suggested by Helmholtz, and very soon after, on the latter's advice, went to Jena. Here Professor Abbe, who at the Carl Zeiss Optical Works was deeply engaged in the scientific and social problems which formed his life's work, very quickly recognised the exceptional ability, energy, and versatility which were characteristic of Dr. Czapski, and made him his confidant and assistant.

Master and disciple worked hand in hand. Abbe's ideal was that of consolidating science, industry, education, and social reform into one harmonious system—the experiment was to be made in the domain of optics, in which, thanks to his discoveries, he had a successful and growing industrial establishment.

The magnitude and diversity of the problems incident on so herculean a task may be imagined; how his ideas led him to the foundation of the Carl Zeiss Stiftung is a matter of common knowledge, but what concerns us here is that in the whole of this work Czapski was a most trusted counsellor, and many of the provisions in connection with the statutes of that unique institution are the direct outcome of his labour. In 1891 he was made a member of the board of management of the Carl Zeiss works; he was likewise on the board of the optical glass works of Schott and Genossen. The two works at that time employed together about 300 people; to-day they employ 2500. Abbe's onerous and multifarious duties were telling more and more on his health, and as time proceeded these consequently devolved more and more on Dr. Czapski, until four years ago, when Abbe retired from the boards of management,

Czapski became head of the Carl Zeiss Stiftung as his chosen successor.

The chief scientific work from the pen of Dr. Czapski was his "Foundation of the Theory of Optical Instruments after Abbe,"* which first appeared as part of Winkelmann's Handbuch der Physik in 1893. A second enlarged and amplified edition was published in 1904. This work, whilst giving a complete and consistent theory covering the whole ground from the standpoint of geometric optics, deals fully with the new modes of treatment of the subject introduced by Abbe, purposely omitting, however, the consideration of instruments and matters which in the author's opinion had already been dealt with comprehensively and adequately by others.

Owing to the absence of any English translation of this masterly contribution to the science of optics, its full value has scarcely yet been recognised. It is safe to predict that as it becomes better known its value will become more fully appreciated.

A few words from the preface of the book, which undoubtedly contains a deal of original work also on the part of Czapski, may serve to illustrate the natural modesty and innate sense of fairness of the man :—"The contents are essentially the product of Abbe's mind. But as regards the presentment of the subject, though I have been in constant intercourse with my honoured friend and teacher, the trend of circumstances has scarcely permitted us to more than discuss the general outline of the work. Whilst, therefore, I must take full responsibility for the correctness and proper presentment of the subject, I must disclaim all merit for the matter itself."

A book based upon Czapski's work referred to above, and entitled "Image Formation in Optical Instruments from the standpoint of Geometric Optics," has also appeared in 1904, of which parts have been written by Dr. Czapski, in collaboration with other members of the scientific staff of Carl Zeiss.†

Apart from his book, Dr. Czapski wrote a number of other optical papers of a varied character from time to time. An interesting study on the Limitations of the Microscope issued from his pen in 1891,‡ in which he compares the theories of Helmholtz and Abbe, treats of the difficulties connected with increasing the N.A. of

* "Grundzüge der Theorie der Optischen Instrumente nach Abbe." Published by Johann Ambrosius Barth, Leipzig; 1st. ed., 1893, 2nd ed., 1904. Both editions have been published separately, as well as in Winkelmann's Handbuch.

† "Die Theorie der Optischen Instrumente. I. Die Bildererzeugung in Optischen Instrumenten," edited by M. von Rohr, published by Julius Springer, Berlin, 1904.

‡ "Die voraussichtlichen Grenzen der Leistungsfähigkeit des Mikroskops." Zeitschr. wiss. Mikrosk., viii. (1891) pp. 145–55. See also article on "The Future of the Microscope," by Czapski, pp. 357–64, in Van Heurck's book on the Microscope, English edition by Wynne E. Baxter, published by Crosby, Lockwood, and Son, London 1893. See also this Journal, 1891, pp. 814–18.

objectives beyond a certain point; and shows how the most likely direction of progress lay in the direction of photography by means of light of shorter wave-length than that employed in visual observations.

Another paper of his, published in 1897, deals with the Greenough Binocular Microscope.* It gives a concise account of the theory of stereoscopic vision as applied in that instrument.

Of microscopical appliances which bear his name may be mentioned the Corneal Microscope; and the special Axial Image Eye-piece with Iris diaphragm, for studying the rings and brushes of crystals.

Dr. Czapski's last paper was one of a popular character relating to the various applications of Photography in Scientific Research.† Photography was a subject in which he had always taken a keen interest, and he was an Honorary Fellow of the Royal Photographic Society. He became a Fellow of the Royal Microscopical Society in 1897, and on several occasions attended the meetings.

Amongst the numerous German societies to which he belonged may be mentioned the Deutsche Gesellschaft für Mechanik und Optik, of which he was Vice-President.

He, with others, was responsible for the editing of Abbe's Collected Papers.‡ He aided in conducting the Zeitschrift für Instrumentenkunde, and at one time was a frequent contributor to its pages.

His valuable services in the cause of science were recognised by the conferment of the title of Professor by the Prussian Ministry.

All who knew Dr. Czapski testify to the winning manners and charming personality of the man. He possessed in a peculiar degree the gift of influencing and inspiring the many classes of people with whom he came in touch; it was a characteristic which aided him largely in the prosecution of his plans, besides securing him a wide circle of friends.

He married at an early age, and leaves a large family. Though his health had for many years not been of the best, his sudden and early death came completely unexpectedly, and will be deplored throughout the world by all interested in the progress of optical science and industry.

Along with Abbe—the great man to the furtherance of whose work he so unselfishly and assiduously devoted himself—will ever be associated his friend Czapski, who outlived him little more than two years.

* "Das stereoskopische Mikroskop nach Greenough." Zeitschr. wiss. Mikrosk. xiv. (1897) pp. 289–303.

† "Der Wert der Photographie für die wissenschaftliche Forschung." Photograph. Corresp., Dec. 1906 and Jan. 1907.

‡ "Gesammelte Abhandlungen von Ernst Abbe," published in 1904–6, by Gustav Fischer, Jena, of which three volumes have so far appeared.

LIST OF PAPERS AND OTHER COMMUNICATIONS MADE TO THE ROYAL MICROSCOPICAL SOCIETY BY DR. CZAPSKI.

The following paper by Dr. Czapski, contained in this Journal, 1890, pp. 11–12, forms part of the Transactions of the Society, "On an Objective with an Aperture of 1·60 N.A. (Monobromide of Napthaline Immersion), made according to the Formulæ of Professor Abbe in the Optical Factory of Carl Zeiss."

Frequent abstracts of other of his papers contributed to the Zeitschr. wiss. Mikrosk., and the Zeitschr. Instrumentenk., have appeared in this Journal, the following being a list of some of these :—

Bamberg's Spherometer Microscope. 1888, p. 280.
Czapski's Ear (Tympanum) Microscope. 1889, p. 112.
Probable Limits to the Capacity of the Microscope. 1891, pp. 814–18.
Use of Polarisation Photometers. 1892, pp. 549–50.
The Dioptric Condition for the Measurement of Optic Axial Angles by means of the Polarisation Microscope. 1892, p. 683.
Abbe's Method and Apparatus for the Determination of Focal Lengths. 1892, pp. 678–82.
Review of Czapski's book on the Theory of Optical Instruments. 1893, p. 588.
Corneal Microscope—simple form. 1893, p. 688.
" " later pattern. 1902, p. 484.
A New Drawing Apparatus. 1895, p. 103.
Illuminating Apparatus. 1895, p. 323.
Czapski's Ocular Iris Diaphragm with Eye-piece. 1896, p. 120.
Greenough's Stereoscopic Microscope. 1898, p. 469.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Study of the Vitellus.‡—H. Dubuisson has made an elaborate study of the yolk—its formation, degeneration, and utilisation—in a variety of types. In the sparrow the formation of the yolk is preceded by a vacuolisation of the cytoplasm, and the yolk is deposited both centripetally and centrifugally in these vacuoles. In the tortoise there is a formative zone at some distance from the periphery, and the yolk is differentiated on both sides of this. Later on a sub-peripheral formative zone appears. In both sparrow and tortoise there is an apparent retardation of yolk-formation in the immediate vicinity of the nucleus. In amphibians the yolk is formed in concentric zones; it spreads in two directions; the nucleus exerts a retardative influence.

In degenerating ova of the sparrow the process begins with the nucleus; the follicular epithelial cells proliferate, and act as phagocytes to the yolk, many of them entering it; the whole cavity of the ovum becomes filled with them; then there is a migration and a connective-tissue stroma is left. In reptiles some of the follicular cells show very large nuclei; a number combine and simulate giant-cells; there is again a penetration of the ovum, and phagocytosis. Similar phenomena are described in other groups, and the general conclusion is reached that the degeneration of ova is due to a phagocytic process on the part of the immediately circumjacent cells. In the same way the author finds that the process involved in the digestion of the vitellus is phagocytic. With great circumstantiality and with abundance of concrete illustrations the author has made an important addition to Metchnikoff's doctrine of phagocytosis.

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Arch. Zool. Expér., v. (1906) pp. 153-402 (5 pls.).

Segmentation of Ovum in Hedgehog.*—E. Ballowitz contributes some facts regarding the early stages of development in this animal. Segmentation does not proceed in strictly geometric progression. The egg plasma divides within the zona pellucida into 3, 6, and 7 blastomeres which are very unequal in size. At other stages also differences in the size of the blastomeres are observable. At the 4-celled stage the egg lies in the middle third of the oviduct. The corona radiata of the follicle cells is lost during the passage of the egg through the oviduct; in the 8-celled stage its last remains have disappeared. At this stage the egg enters the uterus, and it may enter earlier. The zona pellucida is still intact. In no case, except as regards size, is there any differentiation suggestive of ecto- and endoderm at this stage.

Zonal Blastoderm.†—Jan Tur has observed this peculiarity in fowl and crow, and gives a somewhat different interpretation from that of M. Loisel, who attributed the phenomenon to the penetration of spermatozoa in the equatorial region of the egg without fertilisation of the germ. According to the author a zonal blastoderm represents the peripheral part of a blastoderm resulting from normal fecundation, whose central part has secondarily been destroyed. It is, in fact, a pathological condition, and he describes the different stages through which the zonal condition is arrived at.

Size of Litter in Poland China Sows.‡—G. M. Rommel and E. F. Philipps show that this breed of sows has increased in fertility (0·48) during the twenty years between 1882 and 1902. The statistics show that the size of litter is a character transmitted from mother to daughter. It would appear that by judicious selection of sows from large litters, the average for the breed may be increased.

Determination of Sex in Rabbits.§—Achille Russo submits the results of experiments which seem to show that the number of females produced can be greatly increased by sub-cutaneous or intra-peritoneal injections of lecithin.

Cervical Plexus of Sturgeon.‖—A. Ostroumoff continues his studies of the development of the sturgeon, dealing in the present instance with the formation of the cervical plexus. He concludes that the N. hypo glossus arises from the ventral roots of the nerves of the 4th and 5th myotomes (10th and 11th roots of van Wijhe). Other nerves dealt with in the paper are the Plexus pterygalis and the Nervus prozonalis and its branches.

Development of Diaphragm and Stomach of Ruminants.¶—K. Wölfel makes a contribution to this subject. The diaphragm develops in sheep, cattle, and goats, as in other mammals, except that the relations of the pleuro-peritoneal membrane to the primitive kidneys are much more

* Anat. Anzeig., xxix. (1906) 647–8 (8 figs.).
† Comptes Rendus, cxliv. (1907) pp. 992–5.
‡ Proc. Amer. Phil. Soc., xlv. (1906) pp. 244–54.
§ Atti (Rend.) R. Accad. Lincei Roma, xvi. (1907) pp. 362–8.
‖ Zool. Anzeig., xxxi. (1907) pp. 723–5 (1 fig.).
¶ Anat. Anzeig., xxx. (1907) pp. 257–70 (11 figs.).

strongly marked. In ruminants these arise, while the primitive kidneys are present in the cranial region, from the lateral borders of the same; in other mammals they spring from the dorsal body wall. The relations of the developing rumen to the lungs, liver, and diaphragm are described as is also the mechanism of the "turning" of this region of the stomach spoken of by Martin.

b. Histology.

Minute Structure of Parietal Eye in Lacerta and Anguis.*—M. Nowikoff has studied the parietal eye in adults of *Lacerta agilis* and *Anguis fragilis*. He has directed his attention especially to the following points:—the nervous connection between the parietal organ and the brain; the relation of the definitive nerves to the sensory cells; and the structure of the retina.

Intercellular Bridges of Gut Epithelium.†—T. Schaeppi describes these in the gut of frog and mouse. They are protoplasmic strands connecting the epithelial cells across the intercellular lymph spaces. They vary in thickness and are contractile, and assist the wandering of the epithelial cells. Another significance attached to them is that of effecting a nervous *rapport* between the epithelial cells. Since, for example, only certain of the gut cells are directly connected with the nerve-endings, it is natural to suppose that the secretion-impulses are transmitted to the other epithelial cells by means of intercellular bridges.

Symbiosis.‡—A. Famintzin starts from the fact that lichens show a symbiosis of fungoid and algoid organisms. He regards this as a synthesis of autonomous higher organisms from two kinds of simpler organisms. He asks whether there are not many similar cases; whether the green plant-cell in general does not illustrate symbiosis; whether bacteria are not normal symbions in many cases; and so on. His idea is that symbiosis of lichens may give us a useful clue in the analysis of organisms in general, leading us perhaps nearer the elementary vital units, and suggesting possible syntheses, after the example of the chemists.

c. General.

Migration of Birds.§—H. Duncker gives a critical review of researches and opinions on this subject, from Aristotle to the present day. His own chief conclusions on the matter are stated thus:—"The tracks followed by the birds are, on the whole, distribution routes. Prolongation and abbreviation give the length of the distribution, deviation the direction. The centre of distribution is not to be discovered from the tracks alone. The route north of the centre is to be regarded as the 'Sommerfrischlerabschnitt,' the route south from the centre as the 'Winterflüchterabschnitt.' The centre of distribution is liable to alter. By prolongation resident birds have become

* Biol. Centralbl., xxvii. (1907) pp. 364-70 (5 figs.).
† Arch. Mikr. Anat., lxix. (1907) pp. 791-806 (1 pl.).
‡ Biol. Centralbl. xxvii. (1907) pp. 353-64.
§ Wanderzug der Vogel. Jena: G. Fischer, 1905, 118 pp. See also Zool. Centralbl., xiv. (1907) pp. 279-80.

migratory birds." The various categories, resident, wandering, migratory, winter fliers, etc., are necessary for an understanding of the problem; but it must be noted that these groups pass by transitions into each other. The author admits that the young find their way alone.

Preen-gland of Birds.*—E. Trouessart maintains that in ducks, for instance, the secretion of the preen-gland is of real use. It is possible that the secretion is of use to the skin, in keeping it supple and in good condition. It may also be of use in connection with the moulting of the feathers. He confesses, however, that his views are hypothetical.

Ostrich Feathers.†—J. E. Duerden discusses the causes of the defect in ostrich feathers known as "barring." Barring seems to be constitutional, and not a direct effect of low feeding. The presence of parasites among the feathers is not a direct cause of barring, but any factor causing a lowered condition of health conduces to the appearance of the defect. Experimental inquiry is being directed towards solving this complicated problem. The effects of in-breeding and of "quilling" will also be investigated.

A Python's Meals.‡—W. Hartmann describes an astonishing sight which he saw in Hagenbeck's zoological garden. A specimen of *Python reticulata*, about 25 feet in length, swallowed on June 7, 1906, a swan weighing 18 lb., and two days later a roebuck of 67 lb. Another swallowed within two days two roebuck of 28 lb. and 39 lb., and soon thereafter a chamois of 71 lb. In 2½ hours only the hind-quarter and the limbs of the prey were visible. When a flash-light photograph was suddenly taken, the python disgorged its booty in the space of half a minute.

A. Sokolowsky § reports on the same subject. In a few days a weight of 84 lb. was swallowed; 138 lb. in nine days. The pharynx can be dilated to a width of 1 m. 40–50 cm. A goat of 84 lb. in weight was engulfed, and took about nine days to digest. After a meal the pythons remain inert in the water. The appetite for a second large meal a few days after the first is remarkable. On the other hand, two specimens remained from spring to November without eating at all, and yet persisted in good condition.

New Dinosaur.‖—Arthur Smith Woodward describes *Scleromochlus taylori* g. et sp. n., a new diminutive Dinosaurian reptile discovered by William Taylor from the Trias of Lossiemouth, Elgin. As the discoverer pointed out, an outstanding feature is the extreme lightness of the whole skeleton and the peculiar mechanical adaptation of the hind limbs, both of which suggest comparisons with a bird. Compared with Marsh's American Triassic genera of Dinosaura, the new Elgin fossil is remarkable for the relatively large size of the head, the apparently toothless jaws, and the firm union of four long metatarsal bones in the

* Bull. Soc. Zool. France, xxxi. (1906) pp. 140-1.
† Farm and Stock Year Book, 1907.
‡ Zool. Anzeig., xxxi. (1907) pp. 270–2.
§ Tom. cit., pp. 293–6 (1 fig.).
‖ Quart. Journ. Geol. Soc., lxiii. (1907) pp. 140-4 (1 pl. and 1 fig.).

foot. For a geological period so remote as the Trias, the high degree of specialisation in this diminutive Dinosaur is truly astonishing.

Colour-pattern in Tortoises.*—J. E. Duerden shows how in the South African genus *Homopus* a gradation in complexity of colour-pattern can be traced through the five known species, the simple concentric pattern of the shields being broken up into a spotted or rayed pattern. The more highly-differentiated patterns in the allied genus *Testudo* can all be interpreted through the stages found in *Homopus*. In some species the ontogeny of the colour-pattern repeats its inferred phylogeny. The diverse colour-patterns seem to stand in no direct causal relation with environmental conditions.

Viviparity in Proteus anguineus.†—J. Nusbaum describes an interesting case. A female *Proteus*, which had taken no food for 13 months, gave birth to a young animal, 12·6 cm. in length, extremely transparent, with two well-developed eyes, with certain defects in its extremities, but on the whole fully formed. It is probable that it nourished itself at the expense of eggs which had been passed into the oviduct, and that the unusual mode of birth was due to the artificial conditions of captivity.

Swim-bladder of the Flat Fishes.‡—Otto Thilo discusses the subject of the disappearance of the swim-bladder in flat fishes. He indicates in the first instance a number of structural facts, skeletal and otherwise, which point to a relationship between them and *Zeus*, rather than with the Gadidæ. Thus Boulenger's group Zeorhombi is justified. Various young flat fishes, e.g., *Rhombus*, *Solea*, *Arnoglossus laterna*, are known to have a swim-bladder, which later is lost. This loss the author traces to the change of habit from a pelagic to a bottom one. The presence of the bladder would render it difficult for the fish to remain on the sea-floor. Its actual disappearance is brought about by mechanical pressures of various kinds due to differential growth as well as to external conditions.

Frontal Gibbosity in Ptychochromis.§—J. Pellegrin discusses this frontal prominence which occurs in various fishes, particularly in the pharyngognathous Acanthopterygii. He describes it in two species of *Ptychochromis*. It consists of a prominence made up of connective-tissue laden with fat surmounting the occipital crest, and spreading out to the right and left. Its development appears to be related to that of the testes in males; it probably consists of reserves for the development of the sex-glands.

Fishes of Australia.‖—David G. Stead has done a useful piece of work in giving a popular and systematic guide to the study of Australian fishes. He does not attempt to deal with the thousand or so species of fishes from Australian waters, but confines himself to the more im-

* Records of the Albany Museum, ii. (1907) pp. 65–92 (12 figs.).
† Biol. Centralbl., xxvii. (1907) pp. 370–5 (1 fig.).
‡ Zool. Anzeig., xxxi. (1907) pp. 393–406 (7 figs.).
§ Comptes Rendus, cxliv. (1907) pp. 1168–70.
‖ Fishes of Australia, Sydney, 1906, 278 pp. (10 pls. and 88 figs.).

portant and more interesting forms. He supplies much information in regard to economic importance, habits, and adaptations, and has succeeded in making his guide interesting as well as accurate. The book is admirably illustrated.

Mylostomid Dentition.*—C. R. Eastman discusses the dentition of these Arthrodiran fishes, which are essentially like *Dinichthys*, except that their teeth are adapted for crushing instead of cutting. He deals in particular with *Mylostoma newberryi* sp. n. He concludes that all known Dinichthyids, and at least one Mylostomid (*Mylostoma*), have a similar form of "premaxillary," which is the exact homologue of the vomerine teeth in Dipnoans, and that the succeeding pair or pairs (when two are present) of trenchant or crushing plates are homologous with the palato-pterygoid dental plates of typical Dipneusti. The jaws operate in the usual manner, are of the normal gill-arch type, and exhibit precisely the same conformation as those belonging to autostylic fishes. The combined evidence of the majority of characters of Arthrodires proves that they are specialised Dipnoans.

Rate of Tissue Disintegration.†—H. M. Vernon, to shed light on the chemical constitution of protoplasm, made a number of experiments upon tissue disintegration in the kidney of the cat and the rabbit. The fresh kidney was perfused for some days with saline solutions, and the amounts of proteid, total nitrogen, and the ferment erepsin in the perfused liquid estimated. From 27–60 p.c. of the tissue constituents pass into solution. Addition of chloroform or ether to the perfusing liquid greatly increases proteid and ferment disintegration. Already perfused solution causes diminution of proteid and increase of ferment disintegration. Change of salinity stimulates both. These reactions to change of perfusing liquid are proportionate to the duration of perfusion by the alternative liquid, and the effects produced are maximal at first and gradually dwindle. The facts show that even dead tissue reacts definitely to slight stimuli and exhibits some adaptation to environment, making it seem possible that living protoplasm and dead protoplasm differ in degree, not in kind.

Conditions of Tissue Respiration.‡—H. M. Vernon, by perfusion experiments on the excised kidney of the rabbit and the cat, has shown that the gaseous metabolism is at first as great as in the living animal, but dwindles rapidly. The tissue contains about 100 c.cm. of intramolecular oxygen per kilogram. HCN hinders absorption of oxygen. Perfusion with weak solutions of lactic acid, ammonia, sodium fluoride, and arsenious acid causes diminution of gaseous metabolism. Heating the kidney to 55°–60°, and thus coagulating many of the proteid constituents causes a decrease of gaseous metabolism, but does not render it impossible. Loss of proteid from the kidney by disintegration has little effect on the tissue respiration. These last observations support Verworn's hypothesis that respiration depends on non-nitrogenous side chains in the biogen molecules.

* Bull. Mus. Comp. Zool. Harvard, i. (1907) pp. 211–28 (1 pl.).
† Zeitschr. allg. Physiol., vi. (1907) pp. 393–441.
‡ Journ. of Physiol., xxxv. (1906) pp. 53–87.

Plasticity of Organisms and Evolution.*—M. M. Metcalf discusses the influence of plasticity, or individual adaptability, on the course of evolution. A high degree of plasticity hinders evolution by selection, since those congenitally modified in the direction of adaptation have little advantage over those "ontogenetically" adapted. Plasticity may, however, preserve a species in time of stress, till an advantageous trend is established.

Image-forming Power of Various Eyes.†—L. J. Cole tested in an elaborate manner the reactions of certain animals to two sources of light equal in intensity but differing in area, one being a surface, the other a point. He found that *Vanessa antiopa*, *Ranatra fusca*, and two species of frogs, *Acris gryllus* and *Rana clamata*, all of which are positively phototropic, turned more often to the large luminous surface than to the point source, being able evidently to distinguish between the two lights. He inferred that the eyes of these animals possess a certain power of forming an image. *Bipalium kewense*, *Oniscus asellus*, *Tenebrio molitor* (larva), and *Periplaneta americana*, turned as often from the one light as from the other, reacting only to intensity of stimulus, not to size of image. These are all negatively phototropic. *Allolobophora fœtida* and a blinded frog were also indifferent in their reaction, the worm being negatively, the frog positively, phototropic. All these reactions are correlated with the natural habits of the animals.

Equilibration and the Semicircular Canals.‡—L. Bard maintains that the functioning of the sense of equilibrating orientation is exactly comparable to that known for sight in connection with the optic chiasma, and revealed also in pathological hemianopsia. In connection with hearing also there is a physiological chiasma.

Tunicata.

Endostyle of Appendicularisæ.§—J. E. W. Ihle has studied the somewhat complex endostyle in *Megalocercus huxleyi*, and compared it with the simpler type in *Oikopleura dioica* and other species, and the still more reduced type in *Fritillaria pellucida*. In *Kowalevskia* the whole endostyle has disappeared. A careful comparison shows that the endostyle of *Megalocercus* is closely homologous with the endostyle of Ascidians, with its three pairs of glandular zones and three pairs of ciliated streaks. The median streak of ciliated cells in the Ascidian endostyle is absent in *Megalocercus*, but otherwise they are much the same. The conclusion drawn is that the endostyle of Appendicularisæ is not a starting point for the Ascidian endostyle, but is rather a reduced form of it. It is true that the Appendicularisæ retain some primitive features, but they are in other respects specialised for pelagic life, and one of their lines of evolution has been a reduction of the endostyle.

* Science, n.s., xxiii. (1906) pp. 786–7.
† Proc. Amer. Acad. Arts and Sci., xlii. (1907) pp. 335–417 (41 figs.).
‡ Arch. Sci. Phys. Nat., xxiii. (1907) pp. 91–3.
§ Zool. Anzeig., xxxi. (1907) pp. 770–6 (1 fig.).

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Embryology of Paludina vivipara.*—M. Popoff describes the early stages of the growth of the ovum in histological detail. Both male and female sex-cells are distinguished by the presence of chromidia; in *Paludina* as in *Helix* these arise close to the nucleus and show an intimate relation with the chromatin transformations going on in the same. This favours the view that the chromidia arise from the nucleus. The formation of chromidia is not marked in the first phase of growth; it is contemporaneous with the most marked cell activity, and is thus in close connection with the regulating processes of the cell. The "Neben-kern" (idiosome, idiosome residue, etc.) and the pseudo-chromosomes (archoplasm, etc.) in the male sex-cells of *Helix pomatia* are only transition stages in the transformations of the chromidia (mitochondria and chrondromites). In the final stage of sperm histogenesis a part of the chromidia is thrown off along with a little mass of plasma. There is dimorphism of the spermatozoa; there are oligopyrene and eupyrene forms. The former are the more active, but their respective functions have not been made out.

Locomotion of Gastropods.†—R. Dubois and Fred Vlès point out that various interpretations have been given of the creeping movements of Gastropods. The locomotion has been referred to vibratile cilia on the foot, to the flow of blood into the cavernous tissue of the foot, and to the musculature of the foot. The authors have experimented with *Fissurella neglecta*; by elimination of the action of the cilia and the erection due to inflow of blood, they show that the muscular action is the only important factor.

δ. Lamellibranchiata.

Petricola pholadiformis in German Waters.‡—C. Boettger has found this *Pholas*-like American bivalve near Sylt, and between the north Frisian Islands and the mainland. E. Wolf has also found specimens near the east Frisian Islands. This is a very remarkable instance of importation, for the only other known habitat is on the other side of the Atlantic.

Locomotion of Pectunculus glycymeris.§—Fred Vlès describes the movements of this bivalve. It makes its way in the sand by a sort of ploughing, the characteristic features being the antero-posterior oscillation of the shell, and the utilisation of a displacement of the centre of gravity by means of the foot. It raises itself into a vertical position and tumbles over and begins again. On a hard body there is probably a true adhesion of the plantar surface of the foot.

* Arch. Mikr. Anat., lxx. (1907) pp. 43–129 (5 pls.).
† Comptes Rendus, cxliv. (1907) pp. 658–9.
‡ Zool. Anzeig., xxxi. No. 7 (197) pp. 268–70.
§ Bull. Soc. Zool. France, xxxi. (1906) pp. 114–7 (5 figs.).

Structure of Ænigma ænigmatica Chemnitz.* — G. C. Bourne recounts the distinctive peculiarities of this bivalve. His material was collected from amongst the roots of the palm *Nipa*, at Sarawak. Some of the more important facts recorded are here given. *Ænigma* retains more of the typical features of a normal Lamellibranch than *Anomia*. There is a specialised pallial muscle which acts as retractor of the left gill. Adaptations for resisting desiccation during long exposure to the sun and air are found in the thickening and corrugation of the lower moieties of the mantle-lobes and in the existence of cæcal extensions of the pallial cavity, which can be closed by the apposition of the ciliated edges of ridges developed on the mantle and body-wall. The animals are liable to be exposed for days together to the rays of a tropical sun, yet they always remain moist and fresh. The kidneys and the openings of the reno-pericardial ducts and gonaducts into the kidneys are similar to those of *Anomia ephippium*. The gonopores have ciliated funnels. An internal ciliated groove runs the whole length of the cæcum of the crystalline style.

Arthropoda.

a. Insecta.

Treatise on Insects.†—Antonio Berlese deals in fascicles 21 and 22 of his exhaustive and admirably illustrated treatise on insects with the nervous system and the sense-organs.

Factors influencing Insect Development.‡—C. Hennings has experimented with a view to determining some of the factors influencing the time of egg-laying and duration of the development period of insects. His results show that in the case of the Chafer, *Tomicus typographus* L., besides temperature, the amount of moisture is to be reckoned as a regulating factor. With regard to egg-laying, increase of the moisture in the atmosphere when temperature is high causes slight delay; at low temperatures the delay is considerable. Increase in the dampness of the air may lengthen the whole period of development from 1–2 weeks, and this hindering influence of increased moisture is more marked the lower the temperature is. It effects at 24° a delay of 6 days, at 14° a delay of 13 days.

Assimilation of Carbon-dioxide by Chrysalids of Lepidoptera.§—Marie von Linden found that the chrysalids of *Papilio podalirius* and *Hylophila prasinana*, placed in a wet atmosphere charged with carbon dioxide, absorbed the gas, and that instead of losing weight as normally occurs at this stage, they became heavier. The nitrogen of the atmosphere, as well as the elements of water, contributed with the carbon dioxide to form an organic substance rich in carbon.

Predaceous Insects and their Prey.‖ — E. B. Poulton publishes the first part of a memoir on this subject, which is the result of the

* Quart. Journ. Micr. Sci., No. 202 (1907) pp. 253-95 (3 pls.).
† Gli Insetti, Milano, 1907, pp. 585–648 (figs. 698–800).
‡ Biol. Centralbl., xxvii. (1907) pp. 324-37.
§ C.R. Soc. Biol. Paris, lxii. (1907) pp. 360-2, 371-2.
‖ Trans. Entom. Soc. London, 1906, pp. 323–409.

observations of many naturalists brought together in this useful form. The predaceous orders dealt with in the present section are Diptera, Neuroptera, Hemiptera, Orthoptera, and Coleoptera. Certain general conclusions of interest are suggested by a study of the lists, and these are discussed by the author. The Hymenoptera, Diptera, Coleoptera, and Lepidoptera, placed in the order of importance, account for nine-tenths of the recorded prey of the Asilidæ. Other orders are of small importance, but it is a striking fact that Acridiidæ (Grasshoppers) are the only recorded prey among the Orthoptera, and Cicadidæ (with the exception of a single Cercopid) among the Rhynchota Homoptera. Amongst the prey of the Asilidæ there is a great predominance of Hymenoptera, including stinging members of the order; of Coleoptera half the families contributing victims are looked upon as specially protected. These are but a few of the many interesting facts revealed by a study of the 362 separate observations tabulated in this memoir.

Mid-gut Glands of Beetles.* — Jan Hirschler has studied in embryos of *Donacia* the origin of the sub-œsophageal organ. He finds that it has an endodermic origin, and that it is a true liver-like mid-gut gland of paired origin comparable to the liver of Crustaceans, and perhaps to be interpreted as a vestige which attained greater development in more primitive air-breathing Arthropods.

Development of Mid-gut in Trichoptera.†—E. Russ gives some notes on the post-embryonic development of the mid-gut in *Anabolia lævis* Zett. There are cell-nests upon the basal membrane which proliferate and spread out into an epithelium. This raises the larval epithelium which, getting detached, passes into the cavity of the gut and forms what is known as the larval yellow body. The secretion of the new epithelium hastens the solution of the larval yellow body, so that at the end of the larval rest-period there remain no traces of it in the mid-gut. The yellow body of the pupa, which differs in origin and structure from that of the larva, is also described.

Anopheles Larvæ in Flax Pits.‡—A. Bongiovanni finds that a toxin capable of killing larvæ of *Anopheles* is developed in flax-steeping pits in Italy if there is a rapid rise of the temperature to 30°–32° C. The significance of this as a means of checking the distribution of malaria is indicated.

Bionomics of Culicidæ.§—B. Galli-Valerio and J. Rochaz de Jongh have investigated a number of points in the natural history of Culicid genera. With regard to the early spring mosquitos, they find that these arise not from the early laying of eggs by females which survive the winter, but from larvæ and eggs which have lasted throughout the winter. They find that *Lemna palustris* may play an important part in hindering the development of *Anopheles*, while, on the other hand, *Nasturtium officinale* and *Ranunculus aquaticus* favour the deposition of eggs. Wind is not regarded as of much significance in the distribution

* Zool. Anzeig., xxvi. (1907) pp. 766–70 (4 figs.).
† Tom. cit., pp. 708–10.
‡ Centralbl. Bakt. Parasitenk., xlii. (1906) pp. 702–5.
§ Tom. cit., pp. 468–77.

of species. The authors refer to an *Acarus* found upon different species of *Culex*, to which they attribute no injurious effect upon the host. An account is given of experiments with various substances with a view to checking development. Of these melioform appears to be the most satisfactory. A 0·05 p.c. solution checks the development of *Culex* larvæ. Pupæ may develop imagines, but these often cannot leave the pupa-case, and perish on the surface of the water.

Notes on Life-history of Trochilium andrenæforme.*—N. Charles Rothschild records the occurrence of several examples of the larva of this Sesiid, which were found mining in the stems of *Viburnum lantana*. The insect makes a straight mine in the centre of the twig; there is an opening at right angles to the mine from which the larval "frass" exudes and the insect emerges. The structure and habits of this larva are described by Eustace R. Banks, and T. A. Chapman contributes a note on the pupa.

Bionomics of Insect Pests of Olive.†—F. Silvestri and G. Martelli discuss fully the problem of fly-pests of the olive. Accounts are given of their feeding, pairing, oviposition, tunnelling, etc., as well as full descriptions of the various Hymenopterous insects which are parasitic upon them. Particular stress is laid upon this aspect of the problem; analytical tables for the determination of the larvæ, pupæ, and adults are supplied, and the question of multiplying them and the method of utilising them are discussed.

Argentine Sphecidæ.‡—H. T. Fernald describes a collection of Sphecidæ from Argentine which is now in Harvard Museum. Several new species are indicated, and notes supplied regarding synonymy and variability in others.

Müllerian Mimicry in Butterflies of British Guiana.§—W. J. Kaye discusses along with full descriptions a number of cases from the Potaro district, British Guiana. The general conclusion is arrived at that "It must have been quite impossible for Nature to have evolved such minutely close resemblance in unrelated groups without the aid of Müllerian mimicry. It is impossible to imagine that, say, an Erycinid butterfly, *Esthemopsis sericina*, should have arrived at the identical colour and markings of a Syntomid moth, *Agyrta micilia*, purely and simply by a process of syncriptic selection. It is the minutest details in the coloration that dispel such a probability." That the butterflies settled on flowers "unsuitable" for their protection was further definitely proved.

Spermatogenesis of Blatta germanica.‖—A. Wassilieff has investigated this subject. In the spermatogonia and young spermatocytes there is a double nucleolus. The centrosome in the spermatogonia is punctiform. The young spermatocytes attempt division, which is

* Trans. Entom. Soc. London, 1906, pp. 471–82 (1 pl.).
† Boll. del Lab. di Zool. gen. e agraria Firenze, ii. (1907) pp. 1–82.
‡ Bull. Mus. Comp. Zool. Harvard, l. (1907) pp. 263–72.
§ Trans. Entom. Soc. London, 1906, pp. 411–39 (5 pls.).
‖ Arch. Mikr. Anat., lxx. (1907) pp. 1–42 (3 pls.).

suppressed; then ensues the period of growth. The first maturation-division is a reduction-division; the "accessory chromosome" passes on undivided into one of the spermatocytes of the second order. The centrosomes are V-shaped. The second maturation-division is an equation-division. The "accessory chromosome" divides like the other chromosomes; the centrosomes are rod-shaped. Spermatids and spermatozoa, with and without "accessory chromosomes," are indistinguishable. Mitochondria arise from the chromatin substance of the nucleus. They form the "Nebenkern" in the spermatids. The "accessory chromosome" arises from the nucleolus, and must be looked upon as a chromosome destined to perish. Eggs fertilised by spermatozoa with an "accessory chromosome" yield females; eggs fertilised by spermatozoa without an "accessory chromosome" yield males.

Behaviour of Young of Water Scorpion.*—S. J. Holmes has studied the behaviour of the young of *Ranatra quadridentata* Stal., which in general appearance closely resemble the adults. Their movements are very nearly the same as those of the mature insects. The young *Ranatra* are exceedingly voracious, and are often cannibals. The food consists mainly of small crustaceans and insects. A feeble phototaxis is manifested the first day after hatching, and increases gradually as the insect grows older. The death-feigning is not so decided or prolonged as in the adults, and it differs in certain interesting particulars. The young, like the mature forms, can be cut in two while in the death-feint without causing any response.

It is difficult to understand how the death-feint in this species can be of much value to it. The American species does not seem to fly to lights, and even in the European *Ranatra linearis* this a rare occurrence. The American species rarely leaves the water of its own accord on any sort of inducement. "One is therefore strongly inclined to believe that the death-feint, which is manifested only when the insect is in the air, is rather an incidental result of certain physiologieal peculiarities of the organism, than an instinct which has been built up of natural selection for the benefit of the species."

Similarly, it is difficult to account for the strong, and at times almost violent phototaxis which *Ranatra* exhibits. In the air and near a bright light *Ranatra* becomes, sooner or later, strongly positive, often being wrought up to the highest pitch of excitement in its efforts to reach the light. But the utility of this curious behaviour is quite obscure.

"Accessory Chromosome" of Anasa tristis.†—Katherine Foot and E. C. Strobell find that in the spermatogenesis of this form there is no "accessory chromosome," no odd "heterotropic" chromosome; that the so-called "chromosome nucleolus" of the resting stage is the homologue of the nucleolus of the egg; that in its form and time of disappearance it bears a striking resemblance to the plasmosome of the egg of *Allolobophora fœtida*.

New Parasites of Kermes.‡—K. Šulc describes a peculiar rod-like organism — *Kerminicola kermesina* g. et sp. n. — which he found in

* Biol. Bulletin, xii. (1907) pp. 158–64. † Tom. cit., pp. 119–26.
‡ SB. k. Böhm. Ges. Wiss., xix. (1906) pp. 1–6 (2 figs.).

abundance in the perivisceral fluid of the Coccid *Kermes quercus*. It is probably one of the Saccharomycetes. Another species, *K. physokermina* sp. n., occurs in *Physokermes abietis*.

F. Vejdovský* discusses the same forms and the interest of the discovery that fungoid organisms of this sort seem to be constant symbions of Coccids. This may lead to some new view of the economy of these insects.

Insect Bionomics.† — F. Merrifield pleads for a fuller study of the life and habits of insects and their environmental relationships, as a step towards the better understanding of the web of life. Among special points discussed in his address the following may be mentioned. Failure of food is not often the cause of the extinction of herbivorous insects, but rather the numerous enemies they have to cope with. Many characters seem to be biologically indifferent. Habits are often of great biological importance, but many are not directly connected with nutrition or reproduction, and seem to be merely expressions of the *joie de vivre*.

Procession of Cnethocampa pinivora.‡—H. H. Brindley records some observations on a "wild" procession of *Cnethocampa pinivora* in the Landes (Cap Ferret woods), confirming many of Fabre's results. The procession was attacked by Tachinid flies (*Dexodes machairopsis*). The flies propped themselves up on their wings, pushed at the larvæ with their feet, and attempted to inject their eggs on the bare ventral surface. They avoided the hairs of the larvæ, which possess urticating properties. A useful summary of known facts concerning the procession is given, but it is pointed out that much still remains obscure.

γ. Myriopoda.

Tracheæ of Julus.§—H. E. Ziegler communicates some observations on the tracheal system of *Julus*. He calls attention, for instance, to the multitude of fine tracheæ which pass from the 4th and 5th segments towards the head. The stigmatic pouches are too thick-walled to have any direct respiratory significance; they give origin to the tracheæ, but the two pairs of stigmatic pouches in each double segment do not give rise to similar tracheæ. From the anterior pair there arise two bundles of very fine tracheæ, which go to the musculature of the limbs and to various organs, but do not branch. These are comparable to the tracheæ of *Peripatus*. From the posterior pair of stigmatic pouches there arise tracheæ with a wider lumen and a relatively thick hypodermis. These resemble the tracheæ of Insects. Many detailed points of interest are noted, but a full account will be published by H. Krug, one of Professor Ziegler's students. The following conclusions are drawn:—

1. The tracheal pouches of true Tracheata are segmental organs. In Diplopoda they are in very close relation with the limbs, and serve for

* SB. k. Böhm. Ges. Wiss., xix. (1906) p. 6–12 (1 fig.).
† Pres. Address, Entomol. Soc., 1907.
‡ Proc. Camb. Phil. Soc., xiv. (1907) pp. 98–104.
§ Zool. Anzeig., xxxi. (1907) pp. 776–82 (3 figs.).

muscle-insertion. In *Peripatus* the tracheal pouches are numerous in each segment, and do not serve for muscle-insertion. Perhaps those of Diplopoda correspond to enlarged tracheal pouches of Onychophora.

2. The tracheal pouches of *Peripatus* have a fine cuticle; those of Diplopoda have a strong chitinous layer, but this difference is of subordinate importance, being correlated with the difference in the general cuticle of the body.

3. The tracheæ of *Peripatus* have a great resemblance to the fine tracheæ of Diplopoda.

Tracheæ in Polydesmus.*—W. Effenberger describes the tracheal system of this Millipede. In each ordinary segment there are in close relations to the limbs four tracheal or stigmatic pouches of complex form. From these there arise the tracheæ, which are all of one kind, namely, fine tracheæ, of very narrow lumen, without observable spiral thread, and never branching or uniting with others. A sketch of their general distribution is given. The supply of the anterior region is discussed more particularly.

δ. Arachnida.

Structure of Spiders' Eyes.†—E. Widmann has studied the minute structure of the eyes in species of *Epeira*, *Zilla*, *Meta*, *Tegeneraria*, *Theridium*, *Amaurobius*, and *Lycosa*. He describes (A) the "inverted" type seen in the two anterior median eyes ("main eyes" of other investigators) where the rods lie in front of the entrance of the nerve, and (B) the "vertierte" type, seen in the other six (or 4) eyes ("accessory eyes" of other investigators) which arise as simple invaginations of the ectoderm. He distinguishes three groups of B, according to the nature of the tapetum.

Note on Spelæorhynchus præcursor Nn.‡—L. G. Neumann calls attention to the fact that this Acarid which he described provisionally as a parasite of the ox, from Africa, was associated in error with *Hyalomma ægyptium*. It appears that *Spelæorhynchus* is a parasite of bats, and that tropical America, not Africa, is the locality to which it should be referred.

ε. Crustacea.

Regeneration of Caudal Filaments of Apus cancriformis.§—O. Rabes has observed clear and perfect regeneration in this case. After three moults the animal was superficially normal. The mutilation was effected on October 22: the restitution was complete on November 26.

Nephro-phagocytes of Crustacea.‖—L. Bruntz describes these in Decapods and Stomatopods. They have already been noted in Isopods, Amphipods, Leptostraca, and Schizopods. They are cells which are at once excretory and phagocytic; they have been observed taking in solid particles at the same time as they are eliminating injected coloured

* Zool. Anzeig., xxxi. (1907) pp. 782–6 (4 figs.).
† Tom. cit., pp. 755 62 (7 figs.). ‡ Arch. de Parasitol, x. (1906) p. 220.
§ Zool. Anzeig., xxxi. (1907) pp. 753–5 (4 figs.).
‖ C.R. Soc. Biol. Paris, lxii. (1907) pp. 423–5.

liquids. Their defensive role has been witnessed in their eliminating the spores of a sporozoon.

Duration of Larval Life of Eucyphotes.*—H. Coutière finds an extremely wide range in the duration of larval life between the zoæa stage and the recognisable young of *Eucyphotes*. He has examined a whole series of *Mysis* larvæ of this genus of the same morphological aspect whose sizes ranged from 6–53 mm. It is doubtful if these large larvæ are normal, and if they ever reach the adult stage.

Affinities of Genus Funchalia.†—E. L. Bouvier points out that *Hemipenæopsis villosus* Bouvier is the young stage of *Funchalia woodwardi*, and that *Grimaldiella richardi* Depuis is the last larval stage of the same, adducing evidence in favour of this conclusion. *Funchalia* is to be placed at the base of the Penean series, along with *Penæus* and *Artemesia*.

Regeneration of Vestigial Organs.‡—C. Zeleny records the interesting case of a blind crayfish which re-grew in place of the right (functionless) eye-stalk which had been excised, an antenna-like organ. The new organ consisted of a slender feeler-like process covered with hairs, and having the appearance of being functional. The terminal third is unsegmented, but the basal two-thirds is divided into segments. Its interest lies in the fact that here is an apparently functional organ replacing a removed non-functional one.

New Blind Gammarid.§—K. Schäferna describes *Typhlogammarus mrázeki*, a new species which he makes representative of a new subgenus *Typhlogammarus*, related to *Gammarus* and *Bathyonyx*.

New British Terrestrial Isopod.‖—Alexander Patience describes *Trichoniscus stebbingi* sp. n., which he found in a field near Alexandra Park, Glasgow (in company with *T. pygmæus* and *Trichoniscoides albidus* Budde-Lund, in one of the propagating houses in the Botanic Gardens, Glasgow, and in various localities (Renfrewshire, Ayrshire, Lanarkshire). This new species is at once distinguished from all the other British species of *Trichoniscus*, by the form of the last segment of the metasome, which is broadly and evenly rounded at the tip, instead of being truncate. He also reports *T. spinosus*, which offers some points of resemblance to *T. stebbingi*.

Indian Entomostraca.¶—R. Gurney notes that knowledge of the Entomostraca of India is most meagre. Apart from the Phyllopoda, of which several have been recorded by Baird and Sars, we know practically nothing. He has done something to remedy this defect by describing some fresh-water Entomostraca in the collection of the Indian Museum, Calcutta, and adds to the Indian fauna fourteen species, e.g. *Estheria indica* sp. n., *Daphnia fusca* sp. n.

* Comptes Rendus, cxliv. (1907) pp. 1170–2. † Tom. cit., pp. 951 4.
‡ Proc. Indiana Acad. Sci., 1905, p. 160.
§ SB. k. Böhm. Ges., xxii. (1906) pp. 1-25 (1 pl.).
‖ Journ. Linn. Soc. (Zool.), xxx. (1907) pp. 42–4 (1 pl.).
¶ Journ. Asiatic Soc. Bengal, ii. No. 7 (1906).

Annulata.

Palolo Worm.*—W. M. Woodworth gives an account of this once mysterious worm. He confirms from direct observations Ehlers' description of the "Palolo" as the epitokal posterior portion of *Eunice viridis*, and supplements earlier accounts in various particulars. The discharge of the sexual products is likened to an explosion; all that is left afterwards is a small shrivelled mass. The collapsed integument shows distinct lateral rents, sometimes extending through several segments; the sexual products are evidently discharged through these simultaneously along the whole length of the "Palolo." This mode of discharge accounts for the apparent sudden disappearance of the dense swarms of worms a short time after their appearance. On the day before the rising of the Samoan "Palolo" a small headless Annelid appears in large numbers, which also has the sexes distinguished by brown and greenish tints. Some particulars regarding this form, which is tentatively named *Eunice dubia*, are given.

New Enchytræid.†—R. Issel describes *Fridericia ilvana*, a new Enchytræid from Elba, where he also obtained *F. leydigi* Veyd., *F. bulbosa* Rosa, and *Bucholzia sarda* Cognetti.

Nematohelminthes.

Classification and Distribution of Nematoidea.‡—A. Schepotieff gives a clear statement of the faunistic distribution of the Nematoidea and provides a classification of the group. The Desmoscolecidæ occur in greatest numbers in the sub-littoral and in the deep-sea regions. In the coast zone, especially amongst algæ, examples are few. The Echinoderidæ occur almost exclusively in the coast zone. In the sub-littoral they are rare, and at depths of more than 200 m. they do not occur. *Trichoderma* is found in pretty large numbers in the deep-sea zone only. *Rhabdogaster* on the whole is not rare in any of the zones, from the lowest ebb-zone to the greatest depths investigated. The Chætosomatidæ occur in large numbers in the coast zone; single examples occur rarely also in the other zones, but they never occur in the absence of algæ.

Filaria in Man.§—R. Penel has made the interesting discovery that *Filaria loa* is the adult form of *Filaria diurna*. *Filaria loa* is a parasite of the superficial connective-tissue in all parts of the body, and not of the eye only.

Parasites from the Gharial.‖—O. von Linstow describes from two Gharials at Calcutta the following parasites:—*Micropleura vivipara* g. et sp. n. from the mesentery, a new genus related to Filaria; *Typhlophoros lamellaris* g. et sp. n. from the stomach, a new form

* Bull. Mus. Comp. Zool. Harvard, li. (1907) pp. 1–21 (3 pls.).
† Ann. Mus. Nat. Genova, xlii. (1905–6) pp. 5–8 (5 figs.).
‡ Zool. Anzeig., xxxi. (1907) pp. 132–61 (25 figs.).
§ Les filaires du sang de l'homme. Paris: F. de Rudeval, 2nd ed. 1905. See also Centralbl. Bakt. Parasitenk, Ref., xxxviii. (1906) pp. 703–4.
‖ Journ. Asiatic Soc. Bengal, ii. No. 7 (1907) pp. 269–71 (1 pl.).

belonging to the section Resorbentes; and *Porocephalus indicus* sp. n., a Linguatulid from the trachea and lungs.

Platyhelminthes.

Tænia tenuicollis Rud.*—J. Theinemann gives a detailed account of this parasite, based on a study of many examples, and compares it with other parasites of the Mustelidæ, viz., *T. intermedia* Rud., *T. brevicollis* Rud., and *T. conocephala* Dies. *T. tenuicollis* Rud. belongs to the Cystotæniæ in Leuckart's sense, and to the genus *Tænia* according to the newer definition, whose type is *T. solium*.

New European Distomids.†—A. Looss describes from a frog at Cambridge a specimen of *Opisthioglyphe rastellus* (Olsson), a genus which he has for many years erroneously regarded as identical with *O. ranæ* Fröl. An account is also given of *Ityogonimus filum* sp. n. from the gut of *Talpa europæa* from the neighbourhood of Leipzig; of *Platynosomum semifuscum* g. et sp. n. from *Circætris gallicus* at Genoa: and *Pachytrema calculus* g. et sp. n. from the gall-bladder of *Larus ridibundus* and *Larus argentatus* at Trieste.

New Trematode Genus.‡—W. Nicoll describes anew *Parorchis acanthus* g. et sp. n., formerly established by him as *Zeugorchis acanthus*. It occurs in the rectum and bursa Fabricii of gulls, *Larus argentatus*, and *Larus canus*. One of the most characteristic features of this Trematode is the condition of the excretory system. This consists of a small median irregularly-shaped vesicle, placed posteriorly, into which open two median and two lateral vessels; the latter are divided by septa into numerous lacunæ, and as they pass forward branch into numerous smaller vessels.

Chromosomes in Ovum of Planaria gonocephala.§—W. Schleip finds that the oogonia contain sixteen chromosomes which divide longitudinally. Eight double chromosomes are formed in synapsis. In the first directive spindle there are eight annular double chromosomes comparable to tetrads. The first division is probably a reduction-division, separating the single chromosomes united in the synapsis. The second is an equation-division, in which there is longitudinal cleavage of the single chromosomes. The author's results agree with those reached by A. and K. E. Schreiner in regard to *Myxine* and *Spinax*.

Structure of Catenula lemnæ.‖—Al. Mrázek gives an account of this Turbellarian, especially as regards the excretory system, alimentary system, and the parenchymatous tissue. Previous investigators seem to have missed all the alimentary system except the pharynx. In the formation of the new gut of a bud, the gut of the parent plays no part. The genus cannot be merged in *Stenostoma*; the possession of a statocyst is in itself enough to define off *Catenula*.

* Arch. Natur., 1906, pp. 227–48 (1 pl.).
† Centralbl. Bakt. Parasitenk. (1907) pp. 604–18 (4 figs.).
‡ Quart. Journ. Micr. Sci., No. 202 (1907) pp. 345–55 (1 pl.).
§ Zool. Jahrb., xxiii. (1906) pp. 357–80 (2 pls.).
‖ SB. k. Böhm. Ges., xxvii. (1906) pp. 1–8 (4 figs.).

Double Forms of Fresh-water Turbellarians.*—E. Sekera describes double forms of *Macrostoma hystrix* and *Prorhynchus balticus*. They are not artificially double, but double *ab ovo*. The author agrees with Vejdovský and Korschelt that all such embryonic twins arise from the twin development of one ovum.

Teratology of Planarians.†—E. Sekera describes some interesting forms of *Planaria albissima*, showing lateral budding, a terminal bud at right angles to the parent, and so on. There seems to be great plasticity in the asexual multiplication and in the regenerative processes.

Polypharyngeal Planarian.‡—Al. Mrázek describes from Montenegro a second polypharyngeal species of *Planaria* (*Pl. anophthalma* sp. n.). In addition to the main pharynx there are two accessory pharynxes. In a previously described species (*Ph. montenigrina*) there were at least five, usually 9–14, pharynxes. The new species is quite eyeless.

European Temnocephalid.§—Al. Mrázek has found in the delta of the Moräca river at Scutari lake, near Plavnica, a European representative of the Temnocephaloidea. It was living on the small fresh-water Decapod *Atyaëphyra desmarestii* Joly. It is smaller than any form previously described (from Central and South America, Madagascar, Indo-Malayan, and Australian regions), and has many peculiarities. As the first European representative of an important class it is of great interest. The name proposed is *Scutariella didactyla* g. et sp. n.

Classification of Rhabdocœla.‖—A. Luther proposes some changes in the systematic arrangement of the Hysterophora. He defines the differences between the Catenulidæ (= Stenostomidæ, Vejd.) and the Microstomidæ. The former family appears to be a provisional group; the only character common to all its genera is the absence of a prepharyngeal gut division. The Microstomidæ include the family Microstomidæ, Vejd. and Macrostomidæ E. Bened., which are reduced to sub-families.

Genito-intestinal Canal in Polyclads.¶—W. A. Haswell concludes from a consideration of the structure of the female ducts in several Polyclads, that the genito-intestinal passage of the Heterocotylea is the homologue of a passage or receptacle which, though usually ending blindly, opens in certain cases on the ventral or the dorsal surface. This appears to strengthen the contention of Goto that the genito-intestinal canal, and not the vagina of the Heterocotylea, is the equivalent of the "Laurer's canal" of the Malacocotylea.

Green Cells of Convoluta roscoffensis.**—F. Keeble and F. W. Gamble continue their work on this problem, with highly interesting

* SB. k. Böhm. Ges., xiii. (1906) pp. 1–15 (8 figs.).
† Op. cit., xxxiv. (1906) pp. 1–14 (10 figs.).
‡ Op. cit., xxxii. (1906) pp. 1–18 (1 pl. and 3 figs.).
§ Op. cit., xxxvi. (1906) pp. 1–7 (1 pl.).
‖ Zool. Anzeig., xxxi. (1907) pp. 718–23.
¶ Tom. cit., pp. 643–4.
** Quart. Journ. Micr. Sci. No. 202 (1907) pp. 167–220 (2 pls.).

results. *Convoluta roscoffensis* is hatched colourless, and at this stage contains neither green cells nor antecedents of green cells. Infection takes place from sea-water or from the egg-capsule to which the infecting organism is chemotactically attracted, and on which it habitually settles down and develops. Experiment shows that the green cells of adult *Convoluta* are incapable of life apart from the body of the animal; histological examination—proving that the development of the green cell within the body is accompanied by degeneration of its nucleus—supplies the explanation. The infecting organism has been isolated, and by the addition of it to colourless *Convoluta* the green animal has been synthesised. The green cells serve as an excretory system to the animal; the relation between them and the animal changes with their development, passing from symbiosis to parasitism of the animal on the algal cells. The association leads to marked changes of habit on the part of the animal, e.g. to its ceasing from the ingestion of food. The green cell shows the essential characters of the Chlamydomonadeæ, and may be provisionally placed in the genus *Carteria*.

New Species of Nectonemertes.*—Mary R. Cravens and Harold Heath describe the structure of *Nectonomertes pelagica* sp. n., from off the Californian coast. The variations in their specimens are fully as great as those separating *N. mirabilis* and *N. grimaldii*. It is pointed out that *Nectonemertes* resembles *Amphiporus* in several fundamental particulars, and the authors are inclined, with Bürger, to believe that the two have had a common progenitor.

Incertæ Sedis.

Plumes of Cephalodiscus.†—W. G. Ridewood has investigated the development of these in three recently discovered species, as well as in *C. dodecalophus*, and concludes that the torsion of the axes of the first and second plumes of the buds described by Masterman does not take place. The grooved faces of the axes of these plumes remain directed towards the dorsal face of the buccal shield throughout life. The last two pairs of plumes do not arise between the first two pairs of plumes and the buccal shield, as described by Masterman, but they arise on the dorsal side of the plumes, i.e. the side remote from the shield. Harmer's contention that the series of plumes and post-oral lamella are continuous, is borne out. Separate accounts are given in the paper of the plume development in buds of *C. hodgsoni*, *C. dodecalophus*, *C. nigrescens*, and *C. gilchristi*.

New Species of Cephalodiscus.‡—W. G. Ridewood gives a careful description, with numerous figures, of *C. gilchristi* sp. n., dredged by Gilchrist at the Cape in about 30 fathoms. The polypides, which are male and female, inhabit separate cavities (sub-genus *Idiothecia*); there are six pairs of plumes; the buccal shield has a broad dark margin, and the tubarium bears long spines. A key is given for the identification of the seven species of *Cephalodiscus* now known.

* Zool. Jahrb., xxiii. (1906) pp. 387–56 (2 pls.).
† Quart. Journ. Micr. Sci., No. 202 (1907) pp. 221–52 (11 figs.).
‡ Marine Invest., South Africa, iv. (1907) pp. 173–92 (3 pls.).

New Species of Pectinatella from Japan.*—A. Oka describes *Pectinatella davenporti* sp. n., the third known species of this genus. The stocks of this Polyzoon are rarely more than 1 cm. in size; for the most part they are isolated. Blending of numerous colonies into one large gelatinous mass, as takes place in the other two species, has not been observed. A distinctive feature of the individual zooid is the short stomach with few longitudinal folds. The statoblasts also are quite characteristic.

Fresh-water Polyzoa of India.†—N. Annandale gives a list of the species, eleven in all, known to inhabit fresh or brackish pools in India. Valuable critical notes, and records of habitat and distribution, are added. The species belong to the genera *Membranipora*, *Victorella*, *Hislopia*, *Paludicella*, *Plumatella*, *Lophopus*, and *Pectinatella*.

Pectinatella magnifica Leidy in Berlin.‡—W. Weltner records the interesting fact of the occurrence of this native of North America at Berlin, in the Havel of Spandau. He finds that it may multiply, as *Cristatella* and *Lophopus* do, by the separation of masses to form new colonies. A prolongation bearing polypides grows out from the parent, increases in size, and about the fourth day separates to live independently.

Minute Structure of Alcyonidium mytili.§—S. Silbermann gives an account of the histology of all the leading structures of this Polyzoon, e.g. body-wall, tentacles, brain ganglion, alimentary canal, etc. A statement of the course of degeneration of the polypides, and subsequent formation of the sex-products, is also given. On the question of the specific identity of *A. mytili* and *Sarcochitum polyoum*, suggested by Hassall, it is pointed out that the many papillæ and protuberances upon the latter, and absent in the former, are sufficient to separate the two forms. They are, however, together with *Cycloum papillosum*, probably closely related.

Trichoplax, a Planula.‖—T. Krumbach gives an account of observations which lead him to conclude that *Trichoplax*, hitherto classed as a Mesozoan, is the planula of the Hydromedusan *Eleutheria*, but whether it occurs as a normal phase of development, or otherwise, has not been made out.

Echinoderma.

New Deep-sea Starfishes.¶—H. Ludwig gives a preliminary account of *Pectinidiscus annæ* g. et sp. n., in the family Ctenodiscinæ (East African Coast), and the following in the family Porcellanasterinæ—*Thoracaster magnus* sp. n., four new species of *Styracaster*, *Chunaster scapanephorus* g. et sp. n. (South of Sumatra), *Eremicaster* g. n., *Porcellanaster* (s. str.) *vicinus* sp. n., and *Albatrossaster nudus* sp. n.

* Zool. Anzeig., xxxi. (1907) pp. 716–18.
† Journ. and Proc. Asiatic Soc. Bengal, n.s. iii. (1907) pp. 83–93 (4 figs.).
‡ Arch. Natur., 1906, pp. 259–64 (3 figs.).
§ Tom. cit., pp. 265–310 (2 pls.).
‖ Zool. Anzeig., xxxi. (1907) pp. 450–4.
¶ Tom. cit., pp. 312–19.

Sexual Dimorphism in Ophiacantha vivipara.*—R. Koehler finds that this Ophiuroid, collected by the Cape Horn Expedition, shows a remarkable sexual dimorphism. The males have 5 arms and the females always more (6–8). In one specimen he found a *Myzostoma*, which may be new. The only similar case is that reported by Lyman Clarke † of a *Myzostoma* on *Ophioceras* and on *Astroceras pergamena*.

Eyes of Deep-sea Starfish.‡—W. Meurer has studied these in a number of forms, with the following results. Eyes were found in eight species belonging to the families Archasteridæ, Astropectenidæ, and Pentagonasteridæ, whose depths ranged from 628–3667 m. Eyes were absent in the two typical deep-sea families Zoroasteridæ and Porcellanasteridæ, with depth ranges from 463–5868 m. *Pseudarchaster pulcher* from 702 m., and *Dipsacaster* sp. from 791 m., possessed remarkably large eyes; *Plutonaster spatuliger* from 1895 m., and *P. granulosus* from 1700 m., showed a partial disappearance of the eyes. *Cheiraster agassizii* from 1895 m., an eyeless form, has a well-formed eye-pad, and other types show this structure more or less degenerate.

Classification of Echinoids.§ — Fred Vlès discusses the taxonomic value of the maxillary apparatus. Is there a brusque separation between "gnathostome" and "atelostome" forms? Is there any hint of a rudimentary state of the masticatory apparatus? May the remains of the perignathic girdle be represented, for instance, by the small apophysis at the left corner of the mouth of *Spatangus*, which is seen in *Echinocardium cordatum* in stronger expression? If this "plaque de soutien" corresponds to a myophore apophysis, it has more marked analogies with the auriculæ of Homognathous forms than with those of Heterognathous forms. In any case, the question of atelostome Echinoids requires further study.

Cœlentera.

Deep-sea Gorgonids.‖—W. Kükenthal describes five new species of *Thouarella*, a new species of *Caligorgia*, another of *Stachyodes*, and two new species of *Primnoella*.

New Species of Alcyonium.¶—W. Kükenthal describes *Alcyonium brioniense* sp. n. from the Mediterranean. It differs from *A. palmatum* in colour (deep purple red with yellow polyps), size of polyps, armature of polyps, shape of tentacles, number and form of pinnules, and in the shapes of the cœnenchyma spicules. The author notes that of the reputed Mediterranean species, *A. elegans* belongs to the genus *Paralcyonium*, and *A. coralloides* to *Sympodium*, sub-genus *Erythropodium*.

* Zool. Anzeig., xxxi. (1907) pp. 229–30.
† Op. cit., xxv., p. 670.
‡ Tom. cit., pp. 749-50.
§ Bull. Soc. Zool. France, xxxi. (1906) pp. 143–8 (5 figs.).
‖ Zool. Anzeig., xxxi. (1907) pp. 202–12.
¶ Jen. Zeitschr. f. Natur., xlii. (1906) pp. 61–72 (1 pl. and 12 figs.).

Habits of Sea Anemones.*—H. J. Fleure and C. L. Walton, from a study of *Actinia*, *Tealia*, and *Anthea*, conclude that the base and the tentacles are more sensitive than the other parts to mechanical stimuli. In *Anthea* and *Actinia* the tentacles are insensitive to chemical stimuli, unless these are excessive, and the mouth is the region specially sensitive to chemical stimuli. Motor stimuli can be communicated from the tentacle to the mouth, and *vice versâ*. Pieces of filter-paper placed on some of the tentacles of an *Actinia* were carried to the mouth, but after a few trials, lasting over 2–5 days, were rejected by these tentacles. *Actinia* showed no reaction to light, and *Tealia* a variable one. *Sagartia bellis* expanded at nightfall. *Eolis papillosa* is the anemone's most formidable enemy. They are attacked also by *Trochus zizyphinus* and by crabs.

Mesoderm of Cœlentera.†—C. Dawydoff describes in the larva of the Narcomedusan *Solmundella mediterranea* a distinct mesodermal layer. He considers that this embryo closely resembles the embryo of a Ctenophore or of an Annelid, and that the facts favour a near relationship of Cnidaria and Ctenophora. The mesoderm of *Solmundella*, in part at any rate, arises from the ectoderm.

Hydroids of Bermuda.‡—E. D. Congdon gives an account of eighteen species, eight of which are new, viz., *Eudendrium hargitti*, *Clytia fragilis*, *C. simplex*, *Halecium bermudense*, *H. marki*, *Sertularella speciosa*, *S. humilis*, and *Thyrocyphus intermedius*. This is the first list for Bermuda. Few hydroids are found on the exposed southern shore. In a few places especially favourable to hydroid life on the opposite shore, the struggle for foothold is so marked that seven of the small species may be found growing on the larger forms. The Bermuda hydroids show a close relationship to those of the West Indies and the Gulf of Mexico.

Seasonal Variation in Hydra orientalis.§—N. Annandale describes how *H. orientalis* migrates into deeply-shaded corners during the hot weather. It is then small and colourless, has only 4 tentacles, and bears one or two 4-tentacled buds. About the beginning of November the deeply-pigmented, 6-tentacled winter form appears. This cycle seems to be the result of degeneration caused by the unfavourable climate.

Irene ceylonensis.‖—N. Annandale notes the occurrence of this Medusoid, recently described by Browne, from Ceylon, in a brackish pool in the Ganges delta. He also describes the hydroid stage. It is very minute, with a branching hydrorhiza, bearing at intervals single hydrothecæ, and gonothecæ containing a single Medusoid.

Notes on Ctenophora.¶—Fanny Moser discusses some Ctenophora collected by Pictet and Bedot at Amboina (Sunda Islands), e.g. *Hormiphora*

* Zool. Anzeig., xxxi. (1907) pp. 212–20.
† Tom. cit., pp. 119–24 (6 figs.).
‡ Proc. Amer. Acad., xlii. (1907) pp. 463–85 (37 figs.).
§ Journ. and Proc. Asiatic Soc. Bengal, n.s., iii. (1907) pp. 27–8.
‖ Tom. cit., pp. 79–81 (1 fig.).
¶ Zool. Anzeig., xxxi. (1907) pp. 786–90 (1 fig.).

amboinæ sp. n., with peculiarly long and slender tentacles; *Pleurobrachia striata* sp. n., which closely resembles *P. pigmentata* from the Malayan Archipelago; and *Ganesha* (*Lampelia*) *elegans* g. et sp. n., which cannot be included in any of the known orders. The new order proposed is named Ganeshidæ, and the diagnosis reads:—"Flattened in the tentacular axis; provided with annular canal, into which the stomach-vessels and the four subtentacular vessels open; the inter-radial and tentacular vessels spring directly from the funnel; tentacular sheaths are present."

Porifera.

Fresh-water Sponges of India.*—N. Annandale describes five new species of sponge from the Museum tank, Calcutta—*Spongilla proliferens*, *S. crassissima*, *Ephydatia indica*, *Trochospongilla latouchiana*, and *T. phillottiana*. He records *Spongilla carteri* and *Ephydatia robusta* from Himalayan tarns, and gives a list of the Indian forms.

Protozoa.

New Fresh-water Rhizopod.†—S. Awerinzew reports on fresh-water Protozoa from Waigatsch Island (Murman coast). He discusses 17 species and a new form, *Schaudinnula arcelloides* g. et sp. n., with a retort-like shell (like *Campascus triqueter* Penard), and with a quite superficial resemblance in shell structure to *Arcella*.

Fusulina.‡—H. Yabe makes a contribution to our knowledge of the Foraminifera genus *Fusulina*, which he divides into four sub-genera:—(1) *Fusulina* s. str., type *F. cylindrica* Fischer; (2) *Schwagerina*, type *S. princeps* Ehrenberg; (3) *Doliolina*, type *D. lepida* Schwager; and *Neoschwagerina* n. subg., type *N. craticulifera* Schwager.

New Radiolarian Family.§—A. Popofsky has found amongst the material of the German South Polar Expedition representatives of a new Radiolarian family, embracing two new genera. This family, termed Lithacanthidæ, is distinguished by possessing four or six thick spines, radiating from a point at right angles to one another, and forming a single skeletal piece. There are upwardly-directed soft flap-like bodies upon the spines. There are also described two species of a new genus, *Conostylus*, belonging to the family Thalassothamnidæ.

Parasitic Euglenæ.‖—W. A. Haswell points out that *Euglena*-like forms may live as endo-parasites in the cells of Turbellarians. In 1892 he noted such a case in a Rhabdocœle, and he has found another in a Mesostomid. The parasites were seen moving about within the protoplasm of certain of the cells of their hosts, often pushing aside the nucleus, or displacing protoplasmic filaments. They were abundant among the spermatozoa in the vasa deferentia and vesicula seminalis. In sections they were found within the cells of the digestive epithelium, but most abundantly in the spaces between the gut and the body-wall.

* Journ. and Proc. Asiatic Soc. Bengal, n.s. iii. (1907) pp. 15–26 (7 figs.).
† Zool. Anzeig., xxxi. (1907) pp. 306–12 (5 figs.).
‡ Journ. Coll. Sci. Univ. Tokyo, xxi. Art. 5 (1906) pp. 1–36 (3 pls.).
§ Zool. Anzeig., xxxi. (1907) pp. 697–707. ‖ Tom. cit., pp. 296–7.

No free *Euglenæ* were found in the water in which the Turbellarian hosts were living.

Chemical Products of Euglenæ.*—O. Bütschli has investigated the chemical composition and physical properties of the films formed by encysted *Euglena granulata*. There are two layers in these films, one of which stains deeply with hæmatoxylin, and yields a carbohydrate-like compound free from nitrogen. The surface of the film has abundance of crystalline carbonate of lime, which may be due to the powers of assimilation of carbon dioxide possessed by the *Euglenæ*. If this is so, it shows that the encysted flagellata assimilate. The second part of the paper treats of the structure and origin of the paramylum grains. These are flattened, ellipsoid, biconvex, or hourglass-shaped, with one or two central cavities, which are canal-shaped, not spheroid, as in starch-grains.

Variation in Infusoria.†—L. L. Woodruff points out that during the life-cycle of many Infusoria, considerable variation of size and shape occurs, along with marked structural and functional changes. Such changes are not abnormal, and ought to be taken into account in the determination of species.

New Dinoflagellates.‡—C. A. Kofoid deals with a large collection of Dinoflagellates made by the 'Albatross' in the eastern tropical Pacific. Noteworthy is the considerable number of new species of *Amphisolenia*, *Heterodinium*, *Ceratium*, and *Oxytoxum*. A new genus, *Acanthodinium*, throws some light on the relationships of the problematical organism, *Cladopyxis*, linking it with little doubt near to the Ceratiidæ in the system. A unique new genus, *Centrodinium*, is represented by three species, and *Murrayella*, related to *Oxytoxum*, is also new. The plates of the obscure and puzzling genus, *Protoceratium*, are defined for the first time, and three species are added to the highly phosphorescent genus, *Pyrocystis*. The discovery of a new representative of *Ptychodiscus*, a genus not reported since its description by Stern in 1883, is recorded. In all, three new genera, eighty-four new species, and nine new "forms" are described.

Structure and Systematic Position of Polykrikos.§—C. A. Kofoid discusses this Infusorian described by Ouljanin (1868) as a Turbellarian, by Bütschli (1873) as an Infusorian, by Bergh (1881) as one of the Cilioflagellata, and so on. He comes to the conclusion that *Polykrikos* is a colonial organism of two, four, or rarely eight zooids, and belongs to the Dinoflagellate family Gymnodinidæ, sub-family Polydininæ. Its peculiar "nettling organs" mark it as worthy of generic distinction. It is represented by a single species, *Polykrikos auricularia*, in neritic plankton, on coasts of Europe and California.

Trichodinopsis paradoxa.‖—R. Issel gives an account of the structure and habits of this very remarkable Infusorian, a parasite of the

* Arch. f. Prot. Kunde, vii. (1906) pp. 197–228 (1 pl.). See also Zool. Centralbl., xiv. (1907) pp. 261–3. † Science, xxv. n.s. (1907) pp. 784–5.
‡ Bull. Mus. Comp. Zool. Harvard, l. (1907) pp. 163–207 (17 pls. and a chart).
§ Zool. Anzeig., xxxi. (1907) pp. 291–3 (1 fig.).
‖ Ann. Mus. Nat. Genova, xlii. (1905–6) pp. 334–57 (2 pls., 8 figs.).

Gastropod *Cyclostoma elegans*. It was originally described by Claparède and Lachmann in 1858, but Issel has found much to add. The animal is referable to the family Urceolaridæ, but there is a remarkable differentiation of pharyngeal armature, and many striking peculiarities.

Amœbidium parasiticum.*—E. Chatton discusses the nature of this peculiar parasitic organism, which occurs on Crustaceans such as *Gammarus pulex*, *Asellus aquaticus*, and *Daphnia*. He comes to the conclusion, based, for instance, on the cellulose membrane, the callous nature of the foot, and the variability of shape, that it is not a Sporozoon, but a plant of low degree—at the same level as Myxomycetes and Chytridiaceæ.

Nuclear Phenomena in Aggregata eberthi.†—L. Leger and O. Duboscq, by artificially infecting *Portunus* with sporocysts obtained from *Sepia*, have been able to follow certain nuclear phases in schizogony. They ascribe a high complexity to the nucleolus (karyosome), and a role in the separation of the chromatin and the formation of the spireme. They note specially the reconstruction of a new nucleus at the expense of a part of the first (the central area of the spireme), while the residual karyoplasm becomes the "cytoplasme germinatif." These observations appear to the authors to make clear the hitherto obscure question of the chromidium.

Chromatin-masses of Piroplasma bigeminum.‡—H. B. Fantham communicates some particulars regarding these. He finds that usually more than one chromatin mass is present in each parasite. In the pyriform and ovoid parasites there are usually present (*a*) a rather large and dense chromatin mass, the nucleus; (*b*) a second, somewhat smaller, usually denser mass of chromatin, the blepharoplast, which is sometimes only punctiform; and many parasites possess in addition (*c*) a rather looser mass of chromatin, of a woolly or mesh-like structure (chromidial reticulum). This last is often relatively well marked. Free forms containing nucleus and blepharoplast were sometimes seen.

Piroplasma of Horse in Italy.§—L. Baruchello and N. Mori describe the horse-sickness which occurs in summer in Rome and the Roman Campagna, as well as many other districts of Italy, and which has hitherto generally been named typhus, typhoid, influenza, etc. It is not a bacterial disease, but is caused by an endoglobular protozoon, and is described as a piroplasmosis. The authors are not prepared at present to identify the parasite as the *P. equi* of Laveran.

Bovine Piroplasmosis in Portugal.‖—A. Bettencourt and I. Borges recount the history of investigation of this disease, known for a long time as *furrujão* (*rouille*) in cattle in Portugal. It is now definitely established as due to the presence of a piroplasma in the blood, and probably transmitted by a tick. The authors describe the parasite, which

* Arch. Zool. Expér., v., Notes et Revue, No. 1 (1906) pp. xvii.–xxxi. (8 figs.).
† Comptes Rendus, cxliv. (1907) pp. 990–2.
‡ Quart. Journ. Micr. Soc., No. 202 (1907) pp. 297–324 (1 pl. and 44 figs.).
§ Centralbl. Bakt. Parasitenk., xliii. (1907) pp. 593–604.
‖ Arch. do real Inst. Bact. Camara Pestana, i., fasc. 2 (1907) pp. 351–62 (2 pls.).

occurs in at least two forms: a round one, 1–2 μ in diameter with a central vacuole, and a piriform. Free forms in the blood are rare.

Myxobolus of Haddock.*—M. Auerbach gives some further notes regarding *Myxobolus æglifini* Auerb. The cysts occur inside the bone or cartilage of the head. If in the former, they lie in a normal hollow unattached; in cartilage the cavity appears to have been caused by the parasites. The spore formation is described; in the pansporoblasts the number of nuclei is 10. Many abnormal spores occur, e.g., with 1 or 3 polar capsules. One gigantic spore 14·4 μ in section was observed.

Bird Trypanosomes of Portugal.†—A. Bettencourt and C. França investigated, both by direct examination and by means of cultures, 153 birds. Of these, 38 yielded positive results, made up as follows:—Diurnal carnivores, 1 out of 12; nocturnal carnivores, 6 out of 15; granivores, 4 out of 27; omnivores, 3 out of 39; insectivores, 24 out of 60. Cultures were found useful in several cases in yielding parasites where direct examination failed to reveal them, but cultures are not satisfactory in species diagnosis. The cultural form is often different in shape and size from the natural form, and cultures of morphologically distinct species may yield identical forms.

Life-history of Echinomera hispida.‡—C. Schellack describes the life-history of this parasite of *Lithobius*, devoting particular attention to structural changes in the nucleus, the mitotic processes, the formation of ova and spermatozoa, the "epuration" phenomena, which Schaudinn regarded as a reduction, and the details of fertilisation.

New Trypanosome.§—A. Laveran describes *Tr. pecaudi* sp. n. from Equidæ and Bovidæ in the Soudan. It can be introduced into most mammals, such as sheep, goats, dogs, rats, mice, with various consequences. The author distinguishes it from *Tr. dimorphon* and other forms.

* Zool. Anzeig., xxxi. (1907) pp. 115–19 (5 figs.).
† Arch. do real Inst. Bact. Camara Pestana, i. fasc. 2 (1907) pp. 333–6.
‡ Zool. Anzeig., xxxi. (1907) pp. 283–90.
§ Comptes Rendus, cxliv. (1907) pp. 243–7.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Polarity in Plant-cells.*—W. Marquette has studied the polarity manifested by the cells of *Isoetes lacustris*, and is of opinion that neither the kinoplasmic nor the dynamic theory is sufficient to account for the behaviour of the polar structures. The latter can be readily distinguished at any period in the existence of the cell, and they are undoubtedly differentiated structures of the cell which multiply by successive fissions. The relations of these bodies and their movements to the spindle fibres show that they are intimately connected with spindle formation. The author thinks that it might be assumed that in *Isoetes* there is transition from a cell with a well-defined centrosome, as in some algæ and fungi, to a cell without anything corresponding to a centrosome as found in the spermaphytes.

Structure and Development.

Vegetative.

Function of Sieve-Tubes.†—M. Molliard has investigated the conditions favouring the formation of sieve-tubes, with the purpose of throwing light on their function. From experiments upon plants grown exclusively in a mineral culture-solution, and others, under the same conditions but with the addition of an organic substance such as saccharose, it appears to be clear that the sieve-tubes are numerous and well developed, while the wood is proportionately backward in development, in direct relation to the supply of organic material. This is especially to be noted in such plants as the Radish. By growing this plant in a solution of glucose, the supracotyledonary region assumed the characters of a rhizome, becoming packed with reserve organic material; at the same time the normal internal structures underwent change, the wood being replaced by phloem with numerous sieve-tubes.

Morphology of Stem of Dennstaedtia punctilobula.‡—H. S. Conard makes a short contribution upon the stem of *Dennstaedtia punctilobula*. The young stem is at first simple; then two branches appear which at once assume the adult form and branch freely. The earliest formed stem is protostelic, having central xylem surrounded by parenchyma, phloem, pericycle, endodermis, and cortex. The central xylem then

* Beih. Bot. Centralbl., xxi. (1907) pp. 281–303 (1 pl.).
† Comptes Rendus, cxliv. (1907) pp. 1063–4.
‡ Johns Hopkins Univ. Circular, No. 5 (1906) pp. 95–8.

gives rise to parenchyma, which in turn gives rise to phloem; finally a sclerotic core appears. There is an ill-defined internal endodermis. There are large leaf-gaps through which the internal tissues successively become continuous with the corresponding outer tissues. This seems to show that the protostele gives rise to the ectophloic siphonostele, which then develops into the solenostele or amphiphloic siphonostele with large leaf-gaps. The cortical tissue does not intrude into the stele, and the central tissue is complete before it joins the homologous external tissue through a leaf-gap. The author concludes that both cortex and medulla are fundamental tissue, and that while we have only to consider two kinds of tissues, vascular and non-vascular, the vascular system has a definite developmental history both in phylogeny and ontogeny.

Differentiation of Tissues in Equisetum.*—C. Queva contributes a note upon the differentiation of wood and phloem in *Equisetum*. The procambial strands appear as isolated groups of small cells, and in each strand the phloem is formed before the xylem. The differentiation of the xylem is exclusively centrifugal, the protoxylem being mostly represented by a lacuna, around which are the remains of the primary tracheids. A second formation of wood continues this centrifugal differentiation to right and left. This metaxylem may, like the protoxylem, break down and form lacunæ, e.g. the lateral lacunæ in the rhizomes of *E. limosum* and *E. littorale*. The vascular bundles of *Equisetum* must not be regarded as simple and unipolar, since there are thus two directions in which the wood is differentiated.

Anatomy of North American Rubiaceæ.†—T. Holm has studied the Rubiaceæ of North America, including *Cephalanthus*, *Houstonia*, *Galium*, etc. The author notes the following epharmonic characters: (1) In the roots: some genera have no exodermis, others have a superficial development of cork inside the exodermis, while in others there is a thick-walled cortical parenchyma; (2) In the stem: *Cephalanthus* has a stereome; there is great variation in the development of collenchyma in the different genera. (3) In the leaves: some genera have bifacial structure, while others have isolateral structure; the distribution of the stomata varies; some species of *Galium* have epidermal resin-cells; the epidermis and cuticle vary; some genera have glandular hairs; the palisade tissue varies in distribution and development; some genera have water-storage tissue in the leaves. Finally, the author confirms the family characters as given by Vesque and Solereder.

Stem-thickening in Euterpe oleracea.‡—H. Kränzlin has investigated the stem of *Euterpe*, and finds that it grows in the same way as other palms, but that a new feature presents itself. In a stem which has a diameter of 5·5 cm., and is already woody, there is a layer of meristematic tissue around the vascular bundles, which multiplies until a thickness of about thirty cells is reached. The stem at this time is about 10 cm. in diameter. Even during cell-multiplication, and for long after, there is progressive radial stretching and wall-thickening

* Comptes Rendus, cxliv. (1907) pp. 862-3.
† Bot. Gazette, xliii. (1907) pp. 153-86 (3 pls.).
‡ Ber. Deutsch. Bot. Gesell., xxiv. (1906) pp. 483-9 (4 figs.).

from the centre towards the outside. When the thickening and stretching reach the outermost row of cells, the growth in thickness of the stem comes to an end.

Anatomy of the Madagascan Raphia.*—R. Claverie has examined various specimens of *Raphia*, and considers that the anatomic characters upon which Sadebeck bases his two species are insufficient; the anatomy of the specimens now examined would show four species, but the author believes that it would be better to consider the number of fibres in each bundle, the diameter of each fibre, and the thickness of the membrane, rather than the points considered by Sadebeck in making his classification. The possibility of the existence of several species is confirmed by the variety of the fruits supplied from the same sources, and the author believes that the preference given to *Raphia* grown upon the west coast is not justified, since the characters of "Raphia clair" are often found in specimens grown on the east coast, and vice-versâ.

Reproductive.

Development of Microsporangium in Cycads.†—F. G. Smith has investigated *Zamia floridana* and other Cycads with special reference to the development of the microsporangium. The sympodial stem of *Zamia* has a vegetative point at the base of each strobilus, from which the staminate strobili successively develop, each with a circle of leaves, and all inclosed in the scale-leaves of the first strobilus. The staminate sporophylls arise in acropetal succession, at first from one, and later on from several hypodermal cells. The microsporangia are grouped in two sori, but their position on the sporophyll varies. The archesporium is a single hypodermal cell, the outer divisions of which give rise to the wall, and the inner ones to the sporogenous tissue. The wall of the sporangium is formed of four to seven layers of cells, those near the apex being much thickened, while a band of similar cells passes down the line of dehiscence. A layer of crystal-bearing cells extends inwards from these thickened cells. Stomata occur on the sporangium. The tapetum, which forms a distinct layer in the tetrad stage, is at least partly derived from sporogenous tissue. The output of spores per sporangium increases according to the number of sporangia on the sporophyll. At the time of shedding the pollen-grain contains three cells—prothallial, generative, and tube.

Pollen Development in Hybrids.‡—R. R. Gates has investigated pollen development in hybrids of *Œnothera lata* × *O. Lamarckiana*, with special reference to mutation. The author disagrees with Pohl as to the failure of pollen development in *O. lata*, but regards the cause as inexplicable. The development sometimes proceeds as far as the tetrad stage, but degeneration always begins then, and may even start as early as the resting-stage. One or two heterochromosomes are formed in the prophase after synapsis; these do not divide, and probably disappear at the end of the first mitosis. Heterochromosomes are also found in

* Comptes Rendus, cxliv. (1907) pp. 510–13.
† Bot. Gazette, xliii. (1907) pp. 187–204 (1 pl.).
‡ Tom. cit., pp. 81–115 (3 pls.).

O. Lamarckiana, and probably represent discarded chromosomes, and this may be a means of lessening the number of chromosomes in certain germ-cells of the species. Extra nuclei are found in the cytoplasm, in the tetrad divisions of the hybrid *O. lata*, and this seems to disprove the purity of other plants, e.g., *Hemerocallis fulva*, where they also occur. It is probable that the mutations of *O. Lamarckiana* arise during reduction division, and that the pollen-grains which give rise to mutants differ greatly from ordinary pollen-grains. The author believes that a cytological basis may be found for the phenomena of mutation in *Œnothera*.

Ovule of Dioon.*—C. J. Chamberlain has investigated the ovule and female gametophyte of *Dioon*. The specimens examined occur abundantly in Mexico, and the plants probably attain the age of over 1000 years. The ovulate strobilus is loose, resembling that of *Cycas*, and the megasporophylls are also leaf-like. There is a three-layered integument, probably derived from two original integuments; only a small part of the nucellus is free. One vascular bundle from the sporophyll supplies the ovule, and sends out branches to the inner and outer layers of the integument. There are usually 4–5 archegonia, but the number varies. Each archegonium makes its appearance in October, when the neck and central cells are formed; the ventral canal and egg nuclei are not formed until the next May. The egg nucleus has 12 chromosomes, this being the largest number known in plants. The central cell and the egg are nourished in the usual way during the earlier stages, but later on the food is supplied through haustoria which pass from the egg directly to the cytoplasm of the jacket-cells.

Development of Ovule in Ginkgo.†—I. E. Carothers contributes the results of her investigations upon the development of the ovule and female gametophyte of *Ginkgo*. The nucellus has a large beak, and the sporogenous tissue is deeply seated. There is usually only one mother-cell, and this has a peculiar kinoplasmic mass. The gametophyte has 8 chromosomes. The lowest spore is the functional one, and is vacuolate, with parietal, free nuclei; later on walls are formed centripetally between these nuclei, until the sac is filled with cells. These cells have their inner ends open, and are sometimes uninucleate, more rarely multinucleate; when the growing cells meet at the centre each forms an end wall. The outer wall of the prothallium is thickened, while the inner wall of the megaspore is a thin, firm layer, surrounded by a very thick outer layer. The archegonia develop while there is still a large central cavity. The gametophyte has much chlorophyll. Around the mother-cell is spongy tissue, which acts as a tapetum. The integument is soon differentiated into three coats: outer fleshy, middle stony, and inner membranous, and two special bundles bring an abundant supply of liquid to this inner layer.

Embryogeny of Cuban Nymphæaceæ.‡—M. T. Cook has investigated the embryogeny of *Brasenia purpurea*, *Cabomba piauhiensis*, and other

* Bot. Gazette, xlii. (1906) pp. 321–58 (3 pls. and 9 figs.).
† Op. cit., xliii. (1907) pp. 116–30 (2 pls.).
‡ Op. cit., xlii. (1906) pp. 376–92 (3 pls.).

members of the Nymphæaceæ, and finds that the development of the embryo-sac is the same in all species. The endosperm nucleus divides, and the antipodal daughter-nucleus enters a tube which penetrates the nucellus, and which is used for transferring food from the nucellus to the endosperm. The endosperm in *Nymphæa* and *Castalia* is cellular, while in *Brasenia purpurea* and *Cabomba piauhiensis* it is nuclear at first, but cellular later. In *Nymphæa advena* the spherical mass of embryonic cells gives rise to a cotyledonary ridge and suspensor; in other species the embryos consist of a single row of cells, which give rise to a spherical embryo with a suspensor. Later on a crescent-shaped cotyledonary ridge is developed around the embryo, and two cotyledonary lobes are formed which may easily be mistaken for cotyledons.

Development and Embryology of Melilotus alba.*—W. J. Young has studied the development of *Melilotus*, and finds that, while the floral organs appear in the order, sepals, stamens, carpel, petals, the last three may appear simultaneously. The archesporium is of late differentiation, and the tapetum is limited. The megaspore mother-cell gives rise directly to the embryo-sac, which increases in size before fertilisation, replacing all the tissue within the integuments. The polar nuclei do not fuse until just before fertilisation. The ovule is first anatropous, later campylotropous. When there are several endosperm-nuclei in the embryo-sac, the egg divides to form a 3-celled pro-embryo, the terminal cell of which gives rise to the embryo, and the second cell to the suspensor. The early development is like that of *Capsella*, but the dermatogen appears later. The embryo-sac is nourished by means of a nutritive jacket formed by the inner integument. The endosperm in the chalazal region acts as a haustorium in the later stages. After formation of the seed-coat, nutritive material passes through the outer columnar cells to special inner tracheids, which then distribute it to the surrounding tissue.

Physiology.

Nutrition and Growth.

Transpiration Current in Plants.†—H. H. Dixon has made investigations upon the transpiration current, with special reference to the results obtained by Ewart, whereby the latter was led to believe that a head of six to thirty-three times the height of the plant would be required to move water in the stems of plants at the velocity of transpiration current. The author shows that there were three reasons for regarding the above conclusion as incorrect, viz.: (1) The velocity of flow given by Ewart was probably much in excess of the maximum velocity of the current in the uninjured plant; (2) the velocity in high trees is not uniform, but falls off from below upwards; (3) the estimate of the resistance was excessive. The present experiments show that the transpiration of the isolated branches used by Ewart is not the same as for all the branches under normal conditions. Also, the water supply

* Proc. Indiana Acad. Sci., 1905 (1906) pp. 133–41 (3 pls.).
† Proc. Roy. Soc., Series B, lxxix. (1907) pp. 41–57 (5 figs.).

largely controls transpiration, a fact neglected by Ewart. Moreover, the resistance appears to have been over-estimated, owing to insufficient care in prevention of air bubbles and clogging at the cut surface. The author maintains that even under the most favourable conditions for transpiration, and with an equal velocity throughout the tree, a head of water of the same height as the tree would be sufficient to maintain the current. Thus, he concludes that Ewart's objections to the cohesion theory are ill-founded, and that this theory is likely to be correct.

Anaerobic Respiration.*—J. Stoklasa, A. Ernest, K. Chocensky have investigated the anaerobic respiration of seed-plants, and have come to conclusion that it is of the nature of an alcoholic fermentation. The experiments were performed upon such plants as the beet and the potato, and various portions of the plant were used, e.g. foliage-leaves, roots, tubers, etc. Similar results were obtained both with frozen and normal material. The foliage of the beet gave off 166·1 mg. in ninety-six hours, while the root gave off 81·5 mg. (calculated for 100 grm. of fresh material).

Respiration of Aerial Vegetative Organs.†—G. Nicolas has experimented upon twenty different species belonging to different orders, with special reference to respiration of aerial organs of vascular plants. His results show that each of the aerial organs has its own intensity and respiratory quotient, those of the stem and petiole being most nearly alike. Those organs which are especially concerned with assimilation, i.e. leaves, plyllodes and cladodes, have the greatest respiratory intensity and the lowest respiratory quotient.

Irritability.

Light Reactions in Volvox.‡—S. O. Mast has studied the effects of light upon *Volvox*. The eye-spots are on the outer posterior surface of the individuals, being much larger on those forming the anterior end of the colony, and probably acting as light recipients. The rotation is usually anti-clockwise, and when swimming horizontally the colony seldom moves parallel with the light rays, the colonies with large daughter colonies or spores showing most deviation. The specific gravity of the colony is less than one, so that when at rest, it sinks. *Volvox* tends to swim in the direction of its longitudinal axis, but gravitation causes the axis to become vertical. The colony orients so as to assume a given angle to the rays of light, and if exposed to two lights of equal intensity, it swims in a middle position. The direction of motion is regulated by the light intensity upon each side of the colony, and is due to motor reactions of the individuals in the colony. Movement is dependent upon the physiological condition, and the time of exposure and intensity of light; it cannot be induced by mechanical stimulation or change in temperature. Weber's law is approximately correct for the light reactions of *Volvox*.

* Ber. Deutsch. Bot. Gesell., xxiv. (1906) pp. 542–52.
† Comptes Rendus, cxliv. (1907) pp. 1128–30.
‡ Journ. Comp. Neurol. and Psychol., xvii. (1907) pp. 99–180 (15 figs.).

Etiolation.*—A. D. Selby has experimented upou *Persea gratissima*, *Asclepias incarnata*, etc., and finds that, while light seems to exert a stimulative effect upon tissue-differentiation, there is no reason to suppose that it retards growth.

Lack of differentiation results in prolonged growth of the meristematic cells in etiolated plants, which thus increase in length and may increase in thickness. If etiolation has not proceeded too far, access of light will induce normal differentiation. The abnormal formation of mechanical tissue in etiolated plants is due to the tensions set by the curvatures which accompany etiolation.

Influence of Light on Assimilation.†—W. Lubimenko has experimented upon seeds of pea, maize, lupin, etc, and upon *Allium*, etc., and finds that the assimilation of the stored organic material is influenced by light. Assimilation is at its maximum when the intensity of light is so weak as to be scarcely sufficient for the formation of chlorophyll, and diminishes in proportion to the increase of the light. The maximum quantities of dry material formed as a result of assimilation, correspond to the varying light-intensities, and vary in the different species.

Fruit-stalk of Cyclamen.‡—F. Hildebrand has studied the movements of the fruit-stalk in the different species of *Cyclamen*, and finds that it is of little importance whether there is a simple bending as in *C. persicum*, or whether there is a two-fold rolling up of the stalk as in other species, so long as the final aim of bringing the fruit earthwards is attained.

The different movements appear to be a case of useless variation.

General.

Plants of Formosa.§—J. Matsumura and B. Hayata have published a useful enumeration of Formosa plants, including the Phanerogams and vascular Cryptogams. It is based on previous literature, chiefly the "Enumeration of Chinese Plants," edited by Forbes and Hemsley, and Henry's list of plantsfrom Formosa, together with the results of collections by various Japanese botanists and by U. Faurie, made within the last ten years. These have added appreciably to our knowledge of the flora, but, as can be seen from the accompanying map, at least half the island (mainly the eastern part) remains practically unexplored. The new species are illustrated by good plates.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Ecology of Philippine Polypodiaceæ.‖—E. B. Copeland writes in much detail upon the comparative ecology of the Polypodiaceæ which

* Bull. Torrey Bot. Club, xxxiii. (1906) pp. 67–76 (4 figs.).
† Comptes Rendus, cxliv. (1907) pp. 1060–3 (1 fig.).
‡ Ber. Deutsch. Bot. Gesell., xxiv. (1906) pp. 559–62.
§ Journ. Coll. Sci. Imp. Univ. Tokio, Japan, xxii. (1906) 704 pp., 17 pls. and map.
‖ Philippine Journ. of Sci., Manila, ii. (1907) No. 1, 76 pp. (4 pls.).

abound near San Ramon in the Philippine island of Mindanao. The combination of so homogeneous a group of plants abounding within so limited an area, has afforded him a rare opportunity of studying the effect of local differences of environment, of interpreting special adaptations and peculiarities of form and structure, and of elucidating genetic affinities. Among the more common phenomena studied were length of stipes, its articulation, presence or absence of indusia, permanence of root-hairs, ciliate or serrate margins. Concurrent evidence on these points was available in two or more genera. The subjects treated of are discussed in the following chapters:—(1) The origin and geographical affinity of the San Ramon fern flora; (2) Local physiography and classification by environment; (3) Adaptations to common environment and to special conditions; (4) Systematic application of the results. The fern flora is shown to be entirely Malayan in origin. The vegetation is roughly classified under the heads: strand, salt marsh, savannah-wood, high forest, rain forest, mossy forest; and the species proper to these habitats are classified in analytical tables showing the thickness of frond and of upper and lower epidermal wall, the presence or absence of chlorophyll in the epidermis, and of a chlorophyll-less hypodermis, the number of stomata per square millimetre, and the average length and width of a stoma. Explanations of these tables are given and liberal comments and deductions added. The rain forest has been so slightly explored that the total of its species falls short of that of the high forest. In the chapter on structural adaptations the main points considered are (1) the vegetative frond (its size and marginal reinforcements, various adaptations for rapid removal of water from the frond and for keeping the nether surface dry, modifications of epidermis and stomata, nature of the assimilating tissue, hydathodes, venation, articulate stipes); (2) the rhizome (its modifications, correlations between length of rhizome and length of stipes, shape or curvature of fronds and pinnæ to catch the maximum of light, etc.); (3) root modifications; (4) humus collectors, e.g. *Thayeria* and some eight other species; (5) myrmecophily, e.g. *Lecanopteris* and *Polypodium sinuosum* (the main service rendered by the ants is a supply of mineral and perhaps organic food in their excreta to plants which from their epiphytic and water-shedding habits have a difficulty in securing a supply of mineral food); (6) reproductive structures (various adaptations, the principles underlying which are, *a*, the protection of the growing sporangium from injury by desiccation, etc.; *b*, the adequate desiccation of the mature spores to insure easy dispersal; *c*, the saving of the frond from injury by desiccation when the spores are mature, the vast majority of Philippine ferns having persistent and not annual fronds). In his fourth and last chapter the author discusses the local fern flora from the systematic side, pointing out some characters observed in groups which are well represented locally, and suggesting the probable genetic affinities of these ferns, a diagrammatic summary of which is exhibited in the genealogical tree given on plate iv. Plates i.–iii. contain 37 figures representing structural details.

Vascular System of Ferns.*—A. G. Tansley publishes some lectures on the evolution of the Filicinean vascular system, part of a

* New Phytologist, vi. (1907) pp. 25–35, 53–68 (figs.).

course delivered by him recently at University College, London. The subject matter is mainly the gross anatomy of the ferns proper, the forms and relationships of their vascular strands. The author, being dissatisfied with the orthodox view that the leaf-trace is the vascular supply of an originally appendicular organ, differing *ab initio* from the axis on which it is borne, adopts the rival hypothesis favoured by Potonié, Hallier, and Lignier, that the fern-leaf is in phylogenetic origin a branch, or rather a branch-system, of a primitive undifferentiated sporangium-bearing thallus. In the first lecture the origin of the Pteridophyta is considered, and the conclusion is reached that the sporogonium of the Bryophyta is not homologous with the sporophyte of the Pteridophyta, but the spores of both are homologous with zoospores of algæ; that the common ancestor was an alga possessing both archegonia and zoosporangia, and possessing a temporary alternation of generations. The primitive megaphylly of the Pteridophyta and the leaf-reduction in the Equisetales and Lycopods are discussed. The second lecture treats of the Botryopterideæ, a group of fossil primitive ferns possessing a great variety of vascular system.

Morphology of the Sporophyll in Ophioglossaceæ.* — D. H. Campbell, having collected in the East Indies abundant material of several species of *Ophioglossum*, of a species of *Botrychium*, and of the monotypic *Helminthostachys*, has studied the question of the morphologic nature of the sporophyll in this group of genera. His conclusions are that it is evident that the bundles which supply the spike are not secondarily given off from the main bundles of the petiole, but are themselves the adaxial (inner) bundles which can be traced from the base of the petiole into the spike. This would indicate that the spike is not a secondary development upon the leaf, but is a primary portion of it; and from a study of the early stages of the young sporophyll it is clear that the spike is really a terminal structure. In the embryo of *O. moluccanum* and *O. pedunculosum* the young sporophyte develops at first only a leaf and root, the definitive sporophyte arising later as an endogenous bud from the primary root. The first leaf must be considered a strictly terminal organ. The author was fortunate enough to obtain near Buitenzorg specimens of the rare *O. intermedium* Hook., the original locality of which in Borneo is lost, and shows that it is not to be confused with *O. pendulum*.

Macrosporangia of Selaginella spinulosa.† — M. Kantschieder publishes a contribution to the history of the development of the macrosporangia of *Selaginella spinulosa*, founded on material from Tyrol and Styria. The sporangium is a product of the vegetative cone, and arises from a single superficial cell of it. The spore-producing tissue arises not only from the archesporium, but also from cells derived from the sporangial stalk; the tapetum is also derived from stalk-cells, and is tardy in development. The sterile cells do not become disorganised at once after the tetrad division of the spore-mother-cell, but gradually disappear as the spores mature. Only four spores are formed in a

* Amer. Naturalist, xli. (1907) pp. 139–59 (figs.).
† Jahresb. Niederösterr. Landes Real- u. Ober-Gymn. in Horn., xxxiv. (1906) pp. 1–15 (figs.).

macrosporangium, but in the microsporangium all the cells of the sporogenous tissue divide up into tetrads; and the author counted as many as 1500 microspores in one sporangium.

Apogamy in Pellæa and Notochlæna.*—H. Wesselowska describes in a preliminary note the main results of her studies of apogamy and apospory in certain ferns, viz., species of *Pellæa* and *Notochlæna*. In every case of apogamy observed the leaf was the first member produced, and was followed by the cauline apical cell, and last of all by the root. Certain deviations were obtained with *N. flavens* when cultivated in darkness. Experiments in regeneration were made upon the above apogamous forms and on a normal species, *Gymnogramme farinifera*, resulting either in the production of new leaf-tissue or in a prothallium, in other words, an artificial production of apospory. Sometimes a bunch of rhizoids was formed at the leaf-apex.

Ferns of Borneo.†—H. Christ describes the ferns collected by Nieuwenhuis and Hallier. He alludes to the physical geography of the island, and divides the ferns of Borneo into four groups—endemic, Malayan, Indo-Malayan, and generally distributed tropical species. The result is 38 species new to the Borneo flora, and of these 16 are new to science; the total fern-flora for Borneo is now 470 species. Among these are 127 endemic species, 144 Malayan, 110 Indo-Malayan, and 30 common to other tropics.

North American Ferns.‡—L. H. Pammel and C. M. King give an annotated list of the vascular Cryptogams of Iowa and the adjoining parts of south-eastern Minnesota and western Wisconsin. This list covers a wider area than that covered by Shimek in his list published one year previously. Short descriptions are given of the physical geography of the district and of the plant-associations found in the various situations. Some photographs of natural fern-growths are added, and for each species a separate map of its distribution in the whole area is given.

L. S. Hopkins § publishes an annotated list of 62 ferns and fern-allies recorded as occurring in Ohio. One of the localities visited afforded as many as 20 species of ferns within a space of half-a-mile.

W. N. Clute ‖ publishes short notes on *Trichomanes reniforme* from New Zealand, on the occurrence of *Asplenium pinnatifidum* in Connecticut, and on a rare cut-leafed form of *Osmunda cinnamomea*. Also he issues a further contribution of his check-list of the North American fern-worts.

R. F. Griggs ¶ describes the diurnal rotation of the leaves of *Marsilia*. Not only do the leaves close upwards at night, but in *M. vestita* at least they face east and west at sunrise and sunset respectively, the mechanism of movement being located in the petiolules of the leaflets.

* Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 85–86.
† Ann. Jard. Bot. Buitenzorg, xx. (1905) pp. 92–140 (1 pl.).
‡ Proc. Iowa Acad. of Sci., ix. (1902) pp. 134–50 (27 pls.).
§ Fern Bulletin, xv. (1907) pp. 1–13.
‖ Tom. cit., pp. 14–24 (1 pl.).
¶ Ohio Naturalist, vi. (1906) pp. 554–5.

Bryophyta.

(By A. Gepp.)

North American Muscineæ.—B. Fink * publishes a memoir of the late Clara Eaton Cummings, of Wellesley College in the United States, author of sundry papers on North American bryophytes and lichens, and part-editor of published sets. A. Lorenz † gives the distribution of the genus *Catharinea* in Hartford County (Conn.), with notes on geology and physical geography. Three species are found. A. J. Grout ‡ publishes notes on various matters, for instance, the aromatic smell of *Conocephalum conicum*; freaks in mosses, abnormal capsules, etc.; and the value of authentic local moss-floras. B. F. Bush § records some occurrences of *Pogonatum tenue* in Missouri and Alabama, and describes the habitats. T. C. Frye ‖ demonstrates that *Catharinea rosulata* C. M. and Kindb. described in Macoun's Canadian Catalogue is in all respects indistinguishable from *C. Selwyni* Kindb., originally described as *Atrichum Selwyni* by Austin. A. B. Jackson ¶ calls attention to the use of *Climacium americanum* by English florists for wreaths and crosses, sometimes dyed. It is imported dry by Oriental dealers and sold as "Resurrection Moss," from its property of expanding when moistened. C. C. Plitt ** writes of the liking shown by ants for the spores of *Webera sessilis* (*Diphyscium foliosum*), and gives instances of the removal of the spores by ants both from freshly-gathered specimens and from plants growing over an ant's nest. He inquires whether other mosses are similarly attacked. C. H. Clarke †† writes of the variation of colour in *Andreæa rupestris* in woods near sea-level at Manchester (Mass.); on one rock were dark red cushions of the moss; on another rock, almost vertical, were flat patches of a dark green colour. Both plants when dried turned black. C. C. Haynes ‡‡ describes and figures two new species of *Aytonia*—*A. Evansii* and *A. jamaicensis*—from Jamaica, collected in 1903 by Evans and Underwood. They are related respectively to *Plagiochasma elongatum* from Mexico and *P. Wrightii* from Texas, and differ from one another in their stomata, ventral scales, and their appendicula, position of androecium, and character of cuticle. E. G. Britton and A. Hollick §§ describe a new species of fossil moss from the Tertiary shales at Florissant, Colorado, under the name of *Glyphomitrium Cockerelleæ*. It is figured with five other North American plant-remains which have been described as mosses. Two of these are, in the opinion of Britton and Hollick, rather Coniferæ, and of two others the generic determination is open to doubt. *G. Cockerelleæ* is the first fossil moss with fruit thus far recorded from America.

Muscineæ of Annam.‖‖—E. G. Paris publishes a list of 36 mosses and 6 hepatics collected by Eberhardt in the Langbian district of

* Bryologist, x. (1907) pp. 37–41 (portrait).
† Tom. cit., pp. 45–7.
‡ Tom. cit., pp. 47–9.
§ Tom. cit., p. 53.
‖ Tom. cit., pp. 53–4.
¶ Tom. cit., pp. 54.
** Tom. cit., pp. 54–5.
†† Tom. cit., p. 55.
‡‡ Bull. Torrey Bot. Club, xxxiv. (1907) pp. 57–60 (2 pls.).
§§ Tom. cit., pp. 139–42 (1 pl.).
‖‖ Rev. Bryol., xxxiv. (1907) pp. 41–9.

Annam, 11 species of mosses and 2 hepatics (described by Stephani) being new to science. One of the mosses, *Endotrichella Eberhardti*, appeared at first to deserve the rank of a new genus, but subsequent study led to its inclusion in *Endotrichella*, of which it constitutes a new section, *pseudo-Meteoriopsis*. The mosses of this region are, with few exceptions, Indo-Malayan, thereby manifesting a very different affinity from that of the phanerogams of the same region, which display an American affinity.

Notes on Species of Philonotis.*—G. Dismier, having received for examination a series of specimens of *Philonotis* gathered in the province of Quebec by H. Dupret, has been compelled to make a special study of the types of *P. Muhlenbergii* Schwaegr. and *P. Macounii* Lesq. and James, and has come to the conclusion that there is no character by which the former can be distinguished from the European *P. marchica*. As to *P. Macounii*, this species was wrongly referred by Kindberg to *P. marchica*; it is a good species, and to it must be referred as a synonym *P. Ryani*, a Swedish species described by Philibert in 1894, and recently found again in Italy. Finally, Dismier has found in an old collection of plants made by Breutel in Greenland some specimens of *P. seriata* Mitt., a species previously unrecorded for North America.

Systematic Affinities of the European Brachythecieæ.†—L. Lorske discusses the systematic relationships of the European Brachythecieæ. This group with its allies have the following pedigree. From Leskeaceæ spring three lines of genera: (1) *Heterocladium — Microthuidium — Thuidium — Cratoneuron*; (2) *Leskea — Pseudoleskea — Ptychodium — Rhytidium — Lescuræa — Homalothecium — Camptothecium*; (3) *Amblystegium — Hygroamblystegium* (as one offshoot), and *Leptodictyon — Chrysohypnum* (as the other offshoot from *Amblystegium*). The author attempted to track out the descent of the Brachythecieæ from *Lescuræa striata* through *Homalothecium*, *Camptothecium*, and *Brachythecium laetum*, but without success. He had therefore to hark back to *Cryphæaceæ* and scheme out the descent as follows: *Alsieæ—Lembophyllaceæ—Brachythecieæ*. The *Brachythecieæ* consist of three lines: (1) *Scorpiurium*; (2) *Eurhynchium—Oxyrrhynchium—Rhynchostegium—Rhynchostegiella*; (3) *Paramyurium* (or *Cirriphyllum*) and *Brachythecium—Bryhnia*. In *Brachythecium* itself he discerns three sub-genera: *Salebrosium*; *Eu-brachythecium*; *Velutinium*.

Physiology of Development in Marchantia.‡—A. Dachnowski publishes an account of his studies of the physiological side of the development of *Marchantia polymorpha*. The subjects investigated were growth of the rhizoids, dorsiventrality, plagiotropic orientation, influences governing the production of the sexual organs, fertilisation. All of these are influenced by external factors, the principal of which are moisture and light, these being of far more importance than the increase or decrease of nutrition and crowding of the plants. As regards the gemmæ, the formation of rhizoids is mainly influenced by moisture;

* Rev. Bryol., xxxiv. (1907) pp. 50–2.
† Allgem. Bot. Zeitschr., xiii. (1907) pp. 1–3, 21–3.
‡ Pringsheim's Jahrb. f. wiss. Bot., xliv. (1907) pp. 254–86 (1 pl. and figs.).

and the general phenomena of development depend upon the degree of maturity of the individual gemma; the plane of dorsiventrality is fixed within 10–20 hours after the sowing of the gemmæ. The plagiotropic orientation is the expression of a function which is influenced by illumination, and is the result of the combined action of diaheliotropism and negative geotropism. When growing in greenhouses *Machantia* reproduces itself by gemmæ only; but, if the light be decreased and the moisture increased, neither gemmæ nor sexual organs are produced; if, however, the intensity of light be increased and the plant be grown in direct sunshine, then, whether the moisture be increased or not, the formation of sexual organs is abundant, being entirely dependent on intense and prolonged illumination. When submerged, the plant produces neither gemmæ nor sexual organs. When growing in conditions favourable to a purely vegetative state, neither gemmæ nor sexual organs are produced, and *vice versâ*. The gemmæ of every plant, male or female, tend to reproduce plants of the same sex. Growth in length of the pedicel of the inflorescence, mode of branching of the thallus, and production of stomata, are mainly controlled by outward factors. Fertilisation occurs mostly during rain by the splashing of water from the antheridial inflorescence.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Sylloge Algarum.*—A. Forti completes another volume of this important work, namely, the part which deals with the Myxophyceæ. The arrangement is on the same lines as that of the preceding volumes, which were compiled by De Toni. They dealt with Chlorophyceæ, Bacillariæ, Phæophyceæ, and Florideæ, and the present volume presumably completes the series.

Algæ of the West Coast of Sweden.†—H. Kylin publishes the result of his studies on the algal flora of the west coast of Sweden, in which he records the species collected by himself in various parts and those in the Upsala herbarium, making altogether a valuable flora of that region. Several new species are described, and critical notes are made concerning many other records. The author then proceeds to the second part of his work, viz. "General Observations on the Algal Flora on the West Coast of Sweden," and this he treats of under the headings: (1) External conditions, including salinity and temperature of the water, and the formation of the coast and sea bottom; (2) algæ regions and algæ formations; (3) comparison between the algal vegetation of the Bohuslan and Halland coasts; (4) position of the flora as regards geographical distribution, including composition of the flora, comparison with neighbouring floras, and suggested reasons for the present composition and distribution of the flora; (5) biological observations. The book is illustrated by plates and text figures.

* Syll. Algarum, v. (1907) 761 pp.

† Studien üb. d. Algenflora der Schwedischen Westküste (Akadem. Abhandl.). Upsala, 1907, 288 pp., 1 map, 7 pls. and 41 figs. in text.

Algæ of Bohemia.*—A. Pascher publishes a further contribution to his algal flora of the Southern Bohemian Forest, in which he not only enumerates all the species found since October 1903, but he publishes all the observations he has made during many years of study upon the morphology and reproduction of different genera of algæ; for instance, the swarming of confervæ, the number of chromatophores in the swarm-spores, characteristics for the limiting of species in *Stigeoclonium*, etc. The paper enumerates 8 Heterocontæ, 186 Zygophyceæ (Acontæ), 129 Chlorophyceæ, 1 Rhodophyceæ, 3 Glaucophyceæ, 132 Schizophyceæ.

Loo-Choo Algæ.†—F. Heydrich publishes a list of 53 marine algæ from the Loo-Choo or Liu-Kiu Islands, Japan, collected by Kuroiwa, and preserved in the Berlin herbarium. Notes are added to records of *Peyssonnelia caulifera* Okam., and *Mastophora macrocarpa* Mont.

Antarctic Marine Algæ.‡—A. and E. S. Gepp publish their full report with illustrations upon the marine algæ collected within the Antarctic circle by the staff of the 'Discovery' during the recent National Expedition (1901–4). The collection consisted of but twelve species, three of which were new to science, and two of which were briefly described in the "Journal of Botany" in 1905. Full details are now given of all the critical species. The most remarkable plants dealt with are two large species of *Lessonia*, confined to Antarctic waters, and unknown to science previous to the recent South Polar expeditions.

Ceramium pallens Zan.§—G. B. de Toni has examined specimens of this alga in Zanardini's herbarium, collected by Vidovich at Capocesto, in Dalmatia. He finds that they are sufficiently near to *C. barbatum* Kütz. as to represent one of the many forms of this polymorphous species. An interesting point in the specimens was the fact that the tetraspores are divided cruciately instead of triangularly. The author remarks on the method of division found in the various genera of Ceramiaceæ, and shows that, though in some of them the division is exclusively either cruciate or triangular, in others this character is not at all constant, even varying in the tetrasporangia of one and the same plant. This is seen in *Seirospora*. In *Ceramium*, the typical division is triangular, but in rare cases cruciate division is found. Among the Ceramiaceæ all forms are represented, from monosporangia to polysporangia.

Conjugatæ from Orense.‖—F. Bescansa gives a list of 25 Desmidiaceæ, 10 Zygnemaceæ, and 2 Mesocarpaceæ, gathered chiefly in the environs of the capital, and from other parts of this province of Spain. To each record are appended its measurement and the locality where it was found. Galicia is rich in fresh-water algæ, due, in the author's opinion, to the humidity of the country, and to its mountainous surface which feeds a large number of rivers and streams. The most richly represented group is that of Conjugatæ.

* SB. Deutsch. Nat. Med. Ver. Böhmen, "Lotos," 1906, No. 6, pp. 1–36.
† Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 100–8 (1 pl.).
‡ National Antarctic Expedition (Nat. Hist.), iii. (1907) 15 pp. 4 pls.
§ Mem. R. Accad. Sci. Lett. Art. Modena, ser. 3, viii. (1907) 9 pp.
‖ Bol. R. Soc. Españ. Hist. Nat., vii. (1907) pp. 65–8.

Lower Forms of Chlorophyceæ.*—R. Gerneck describes a certain number of lower algæ belonging to Chlorophyceæ, which he has been able to isolate from a series of cultures. The material from which the cultures were formed was collected from the neighbourhood of Göttingen. The author describes the composition of the cultivating media, and the manner of isolating the respective algæ. New species were discovered, and these are described in detail in the first part of the paper, as well as many other species previously known which were cultivated with great success. The second part consists of general remarks bearing on the result of the experiments. The cultures were naturally found to be highly dependent on external influences, such as light and temperature, as well as on the cultivating medium. The result of experiments in media of high concentration is described; and the growth of filamentous forms, formation of gelatin, size and structure of the cell, reserve material, resting cells, involution cells, and swarm spores, are all discussed.

Phytoplankton of Warm Seas.†—B. Schröder describes some collections of phytoplankton from the tropical and sub-tropical regions of the Atlantic, Indian, and Pacific Oceans, as well as from the Mediterranean. The results are presented in tabular form according to their locality. Then follow critical remarks and diagnoses of new forms, accompanied by many text figures. Finally the author gives a general summing up of our knowledge of the warm phytoplankton, based on previous work of other authors, and on his own results in the present collection. He describes the phytoplankton of warm water as being principally "polymiktes," consisting of many forms, and but few individuals; only occasionally can a flora be described as "monotonous." Instances of this occur in the Red Sea where *Trichodesmium erythræum* predominates, and in the Mediterranean *Halosphæra viridis*. Lists are then given of the characteristic species of: (1) Warm Atlantic and Mediterranean; (2) Indo-Malay seas; (3) Western Pacific (S. and E. China Sea and Japanese waters). Note is made of certain cold-water forms which occur with various modifications in warm seas.

Plankton of Eastern Alps.‡—V. Brehm and E. Zederbauer publish a general summary of their investigations into the plankton of the lakes of the Eastern Alps, details of which have already appeared in the Verhandl. k. k. Zool. Bot. Gesell. Wien. As regards the phytoplankton, that of the lakes of the higher Alps is very poor both in species and individuals. Of the eleven lakes mentioned, situated between altitudes of 1260–2500 m. above sea-level, and only visited once a year, there are four in which no plankton was found, and three in which only filamentous algæ (*Zygnema*, *Spirogyra*) occurred. In the remaining lakes the composition of the plankton varied much. The plankton of 18 other lakes at a lower elevation was found to be much more uniform in composition. The principal constituents in winter are *Asterionella gracillima* and *Fragilaria crotonensis*, and in summer *Ceratium Hirundinella*. These are typical for all the larger alpine lakes. As regards

* Beih. Bot. Centralbl., xxi. (1907) pp. 221–90 (2 pls.).
† Vierteljahr. Naturf. Ges. Zürich, li. (1906) pp. 319–77.
‡ Arch. Hydrobiol. u. Planktonk., i. (1906) pp. 469–95.

other species, *Oscillatoria rubescens* occurs in masses in Lago Caldonazzo and Zellersee in the winter, and *Staurastrum paradoxum* in Lunzersee.

Plankton of the Japanese Coasts.*—K. Okamura enumerates sixty-seven species of plankton micro-organisms, collected along the coast of Prov. Tosa, in Shikoku, during September and October 1905, and on the coast of Prov. Boshyu, near the entrance to the Gulf of Tokyo, in May 1906. The material comprises a large number of the forms which occur in the warm black current or "Kuroshiwo." All the species recorded in the paper are figured, and a bibliography is added. In a postscript the author gives a short note on the species of *Ceratium*, comparing his views as to the specific value of certain characters with the views of Schröder as expressed in his recent paper "Beiträge zur Kenntniss des Phytoplanktons warmer Meere." Okamura holds that the general form and rigidity of body, as well as the angular flexure and the direction of the horns at origin, are of much greater importance specifically than the length of horns or the manner of curvature in their course.

New Diatom Structure.†—A. A. C. E. Merlin has succeeded in finding a diatomic structure which has not hitherto been recorded, and he describes the details observed in species of *Melosira*, *Hyalodiscus*, *Auliscus*, *Coscinodiscus*, and *Triceratium*. The structure in question consists of a very fine delicate lacework, which covers the central area of some species, and the process caps of others. The author also took dark-ground photographs of two different forms of *Triceratium novæ zelandicæ* × 490. He describes his apparatus, lenses, etc.

"Mare Sporco." ‡ — A. Forti discusses the phenomenon known as "Mare Sporco" (dirty sea), as observed in the Adriatic in 1905. He reviews the opinions of authors as to its origin, rejecting all but micro-biological explanations. He holds that the gelatinous colonies which characterise this phenomenon may be of different sorts according to the different places where it occurs. Roughly speaking, it is caused by lower algæ, especially Bacillarieæ and Peridineæ, which in special conditions, when the salinity of the sea diminishes, reproduce themselves very rapidly in a vegetative manner; later on, when they lose their turgescence and the gas-vacuoles which serve to keep them afloat, they sink to the bottom of the sea, and continue their life-history. He then discusses the various causes which prevent the majority of these organisms from attaining their complete development, e.g. the excessive multiplication of hostile organisms, and particularly the infallible degeneration of the species when vegetative reproduction is not alternated with sexual reproduction. This tendency to degenerate in the case of the phenomenon called "Mare Sporco" is represented first by the dwarfing of the individuals, then by the impoverishment of the siliceous substance, the increase of fragility, and probably also by the attenuation of the vital functions, especially that of the chlorophyll, which appears to be the main cause of the precipitation of the gelatinous

* Annotationes Zoologicæ Japonenses, vi., part 2 (1907) pp. 125–51 (4 pls.).
† Journ. Quekett Micr. Club, x. (1907) pp. 83–6.
‡ Nuov. Giorn. Bot. Ital., xiii. (1906) pp. 357–408.

masses to the bottom of the sea. The author enumerates and describes forty-six species of micro-organisms found by him in material collected in the Adriatic in 1891 and 1905, during the phenomenon of the "Mare Sporco."

Fresh-water Algæ among Marine Plankton.*—E. Lemmermann discusses the behaviour of certain classes of algæ on being removed from fresh to salt water. He finds that most fresh-water plankton forms disappear as soon as the salinity of the water is raised. In those fresh-water plankton forms which do exist in salt-water it is worthy of note that no remarkable change takes place in their floating apparatus; and this is borne out by the plankton of the less saline Baltic sea, which is not very dissimilar to that of the North Sea. From these observations the author concludes that the formation of longer or shorter processes does not depend exclusively on the greater or less specific weight. The number of fresh-water forms observed hitherto in marine plankton is eighty-six.

Algological Observations.†—N. Wille publishes a series of notes on some investigations made by him at Drontheim. The first is on the development of *Prasiola furfuracea*, in which the author describes and figures various stages in the life-history of an extreme form of that species, which was shown to be identical with *P. leprosa* Kütz. A summer form of *Ulothrix consociata* Wille is next described, in which the cell-walls are much thicker, more gelatinous, more retentive of water, and show a more distinct stratification than in the spring form. The distinguishing points are described in detail. The third note is on a new marine Tetrasporacea, which forms the type of a new genus *Pseudotetraspora*, under the name of *P. marina*. A new method of multiplication in *Glœocapsa crepidinum* Thur. is described, in which some of the cells of the colonies divide up into cocci, which separate from each other and develop a mucilaginous cell-wall. The single cells are spherical with a diameter of 2·5–3 μ. Each cell is surrounded by a transparent wall or covering, which is rarely visible except when two of the free-swimming coccus-cells collide. For reasons given in full the author considers that *Aphanocapsa marina* Hansg. is only a developmental stage of *Glœocapsa crepidinum* Thur. The remaining notes are entitled: On *Dactylococcus* (?) *litoralis* Hansg.; on the zoospores of *Gomontia polyrhiza* Born. et Flah.; and Littoral Myxophyceæ and Chlorophyceæ from the surroundings of Drontheim.

Cytological Studies in Cyanophyceæ.‡—N. L. Gardner publishes the results of his researches on the cytology of the Cyanophyceæ, of which he has collected and investigated more than 100 species. His object was to settle certain points about which there has been much controversy, viz. the presence or absence of a nucleus, its structure or functions, the structure of the cytoplasm, the presence of chromatophores, and the nature of the granules. One of the chief difficulties which he had to overcome was the elimination of the sand that adheres

* Arch. Hydrobiol. u. Planktonk., i. (1906) pp. 409–27.
† Kgl. Norsk. Vidensk. Selsk. Skrift. 1906, No. 3, 38 pp., 1 pl.
‡ Univ. of California Publications (Botany) ii. (1906) pp. 237–96 (6 plates).

so closely to these small algæ; and the various methods by which he effected this he describes in detail, as well as the methods of killing, fixing and staining, which he found to be the most successful. By prolonged experimentation he at last discovered a method of differentiating the granules from the chromatin by means of stains, thus avoiding what had been a source of much confusion to previous authors. The very best differential chromatin stain was found to be freshly prepared Ehrlich's hæmatoxylin made from Grübler's hæmatin. With this, it is possible to stain the chromatin without affecting the granules. A summary and digest of previous work on Cyanophyceæ cell-structure is given, special attention being devoted to the recently published views of Kohl, Phillips, and Olive. A brief comparative analysis of the conflicting conclusions of these authors on the respective points at issue is added. The lack of unanimity in their results is shown by the author to be due to their failure to differentiate the structures present in the cell and their eagerness to recognise a complicated mitotic nuclear division. Gardner's own study of the protoplast of the Cyanophyceæ-cell has convinced him of the constant presence of the following three structures: (1) A cell-nucleus more or less sharply delimited; (2) The cytoplasm, extending from the nucleus to the cell-wall, and containing (3) the granules. He treats of each of these structures in detail. The nucleus being large has its shape influenced by that of the cell. And the author shows that in the Cyanophyceæ a series of nuclear structures is revealed—passing by very gradual steps from a simple scarcely differentiated form of nucleus, which divides by simple direct division, up to a highly differentiated form which in dividing shows a primitive type of mitosis, and approximates in structure to the nucleus of the Chlorophyceæ and the higher plants. A new type of nuclear division has been discovered by Gardner in *Dermocarpa*, in which the nucleus breaks up simultaneously into a large number of daughter-nuclei by a process of amitosis. Cell-division is completed in the filamentous forms by the gradual ingrowing of the ring-shaped cell-wall. In some cases the division of the chromatin seems to precede the ingrowing of the cell-wall; in others it accompanies and keeps pace with it; and in still others it is, as it were, passively constricted and cut in two by the ingrowing cell-wall. In its structure the nucleus consists of granules, chromatin and an achromatic ground substance in which the two former substances are imbedded. The author demonstrates two kinds of granules in the cell, one associated with the chromatin in the nucleus and never found in the mature spore; and the other (probably food material) often present in the vegetative cell but always present in the mature spore. One of the products of assimilation is glycogen. No definitely organised chromatophore is found, the cytoplasm holding the colouring matters. No protoplasmic continuity between the vegetative cells appears to exist.

BROCKMANN, C.—**Ueber das Verhalten der Plankton-diatomeen des Meeres bei Herabsetzung der Konzentration des Meereswassers und über das Vorkommen von Nordseediatomeen im Brackwasser der Wesermündung.** (On the behaviour of marine plankton-diatoms in diluted sea-water, and on the occurrence of North Sea diatoms in the brackish water at the mouth of the Weser.)
Wiss. Meeresunters., viii. Abt. (Helgoland, 1906) 15 pp., 7 figs.

KNIEP, H.—**Ueber das spezifische Gewicht von Fucus vesiculosus.** (On the specific gravity of *F. vesiculosus*.) *Ber. Deutsch. Bot. Gesell.*, xxv. (1907) pp. 86–98.

MAZZA, A.—**Saggio di Algologia Oceanica.** (Essay on oceanic algology.)
[A continuation of the notes on species of Florideæ, already noticed in this Journal.] *Nuov. Not.*, xviii. (1907) pp. 65–98.

OLIVE, E. W.—**Notes on the Occurrence of Oscillatoria prolifica Gomont in the Ice of Pine Lake, Waukesia County, Wisc.**
Trans. Wisconsin Acad. Sci. Arts, Lett., xv. (1906) pp. 124–34.

TOBLER, F.—**Zur Morphologie und Entwicklung von Verwachsungen im Algenthallus.** (On the morphology and development of deformations in the thallus of algæ.) *Flora*, xcvii. (1907) pp. 299–307

TORKA, V.—**Algen der Ordnung Conjugatæ aus der Umgebung von Schwiebus.** (Algæ of the Order Conjugatæ from the surroundings of Schwiebus.)
[The species enumerated in this list are described in detail from fresh material, and include new forms of *Closterium obtusum* Bréb. and *Micrasterias denticulata* Bréb.] *Helios.* xxiii. (1906) pp. 91–104.

WITT, A.—**Beiträge zur Kenntniss von Chara ceratophylla Wallr. und Ch. crinita Wallr. mit Taf. u. Fig.** (Contributions to a knowledge of *C. ceratophylla* and *C. crinita*, with tables and figures.) Zurich, 8vo, 1906, 47 pp.

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

Studies in North American Peronosporales. I.—Guy West Wilson* confines his first paper to a consideration of the genus *Albugo*, special attention being paid to the oospores. On the basis of oospore characters, he divides the genus into two groups: the first of these includes all forms in which the oospores are tuberculate or ridged; in the second group they are reticulated. There are two species in which the oospores are unknown, but it is supposed that they would fall into the second group. Wilson describes 13 species, one of which, *A. occidentalis*, found on Chenopodiaceæ, is new to science.

Dicranophora fulva.†—P. Vuillemin describes fully this fungus which grew on *Gomphidius viscidius*. It has been recorded also on *Paxillus involutus* signifying, Vuillemin considers, an affinity between that fungus and *Gomphidius*. *Dicranophora* produces zygospores as well as sporocysts on the same mycelium. The zygospores are very large, up to 200 μ in diameter and black in colour. The other forms of fructification are also carefully described, and illustrated by figures in the text. *Dicranophora* seems to be intermediate between *Sporodinia* and *Spinellus*.

Three Interesting Ascomycetes.‡—W. B. Grove found a specimen of *Dasyscypha canescens* studded with a conidial form which he has named *Acrotheca canescens*. The conidiophores were brown, and bore, at the tips, a number of fusiform conidia. He records also observations made on the spores of *Coryne urnalis*. In the same individual, asci were found with eight spores, and others with four spores, along with a number of smaller spores; in addition, some of the cups produced not asci, but hyphæ, bearing huge numbers of minute allantoid conidia. A

* Bull. Torrey Bot. Club, xxxiv. (1907) pp. 61–84 (10 figs.).
† Ann. Mycol., v. (1907) pp. 33–40 (8 figs.).
‡ Journ. Bot., xlv. (1907) pp. 169–72 (1 pl.).

third Ascomycete, *Eleutheromyces longisporus*, was found on the plasmodium of a Myxomycete. As the spores are septate, he founds for it a new genus *Eleutherospora*, of which a diagnosis is given.

Eremascus fertilis sp. n.*—Rose Stoppel found this new fungus growing in great abundance in some jars of fruit jelly which had not been opened for four years. Cultures were tried and were easily successful, and observations were made both on living and on fixed material. The author found the beginnings of asci on the fifth day after sowing the spores ; there were small outgrowths from the neighbouring cells of the hyphæ which wound round each other, the wall between breaking down at the apex and conjugation of the two cells taking place. The joint cell is the young ascus in which from 4–8 spores are formed. If more spores were developed none of them ripened properly. As to more definite cytological work, the author found that the number of nuclei in the cells of the mycelium was variable—1, 2, or more, up to 15. It was noted that immediately after germination the germinating tube contained 6–8 nuclei. One nucleus was distinguished at the base of each of the ascus-forming outgrowths, which passed into the fused cell; in the young ascus one nucleus alone appears, but always with 2 nucleoli, and it is much larger than the original nuclei. Evidence was forthcoming that mitotic divisions succeeded, but the nuclei were too minute to allow of detailed observations. The divided nuclei always lay over each other.

In many other Ascomycetes a double fusion of nuclei has been proved : the first fusion in the ascogonium, the second in the young ascus, but the author considers the two copulating hyphæ in *Eremascus fertilis* to be equivalent to ascogonium and antheridium such as are found in *Phyllactinia*, and that the nuclear fusion is a sexual act. She discusses the bearing of these phenomena on the systematic position of the fungus, and leaves it close to *Gymnoascus*, although the latter is a much more complicated form.

History of the Development of Ascomycetes.†—P. Claussen has reviewed the papers that have been published on the sexuality of the Ascomycetes in recent years, and gives a history of the progress of our knowledge of that particular branch of cytology. He agrees entirely with those writers who hold as proved the existence of sexuality in many of the forms, and cites at length the different works in which the subject is described and discussed. He also goes into the question of the development of the ascus, and the significance of the nuclear fusion that always takes place in the young ascus. He does not consider it to be sexual fusion, as that would imply a second sexual fusion, which is not probable. The paper is illustrated by figures in the text, and further enriched by an exhaustive bibliography of the subject.

Origin of Yeasts.‡—A Guilliermond takes up the discovery by Viala and Pacottet of so-called asci in a yeast formed from an ascomycetous fungus, and reviews the whole question. He gives a history

* Flora, xcvii. (1907) pp. 332–45 (2 pls. and 6 figs.).
† Ber. Deutsch. Bot. Gesell., xxiv. (1907) pp. 11–38 (7 figs.).
‡ Ann. Mycol., v. (1907) pp. 49–69 (23 figs.).

of work done on yeasts, and insists on the difference supposed to exist between Saccharomyces and the yeasts of the higher fungi, that the former produces endospores while the others do not. He recalls also the work done by Harper and Dangeard on the cytology of the ascus, and contrasts *Saccharomyces* with *Endomyces* and *Dipodascus*. He allows that Viala and Pacottet have made exact observations, but he comes to the conclusion that in their cultures there must have been two fungi, a *Glœosporium* and a yeast, living symbiotically together, and extremely difficult to separate.

Glycogen in Yeast-cells.*— F. G. Kohl considers that glycogen regulates and conditions the absorption of sugar in yeast-cells. The time of most active cell-multiplication and fermentation is the time when glycogen is most abundant. Resting yeast was tested, and the substance was found to be present only in small quantities. The author scarcely looks on it as a reserve product, and he doubts if it functions as such in other fungi; thus it is not found in resting sclerotia, but only when the germination begins. Kohl gives an account of the staining and examination at various stages of the yeast-cells with reference to their glycogen content, and to the changes that take place during sporulation. Though this substance was abundant in the budding cells, it was not found in the spores, so long as they were still within the mother-cell.

Mycological Studies.†—A. Potebnia, from Charkow in Russia, has made a special study of the Sphæropsideæ, and has examined and experimented with 24 different species. He has demonstrated the circulation of protoplasm in the cells, as also the connection of one cell with another by pits in the walls which become almost closed up as in older hyphæ. The observations made on this phenomenon, both in immersed and in aerial hyphæ, are carefully described. Notes are given on the ejection of plasma from the cells. He considers it an abnormal occurrence, and that the plasma loses vitality. External influences, temperature, moisture, etc., induce or hinder this ejection.

Considerable attention has been paid by Potebnia to the systematic arrangement of the Sphæropsideæ: imperfect descriptions and immature specimens are responsible for a good deal of confusion. Then similar morphological members of the Sphæropsideæ have their perfect form in widely diversified Ascomycetes. He has grown these pycnidial forms on artificial media, and he notes the recurring characters that would be helpful in diagnosing and in proving relationship in the groups. He hopes by further study to advance our knowledge of the Deuteromycetes.

Potebnia also gives a list of fungi collected in Gowv. Kursk and Charkow, a few of them being new species; a bibliography of works bearing on the subject discussed, and an index of host-plants with the fungi which he has found growing on them, are added to the paper. The list includes 181 species of fungi.

Ascogenous Forms of Glœosporium and Colletotrichum.‡—C. L. Shear and Anna K. Word have added to our knowledge of the life-

* Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 74–85 (2 figs., 1 pl.).
† Ann. Mycol., v. (1907) pp. 1–28 (3 pls.).
‡ Bot. Gazette, xliii. (1907) pp. 259–66.

history of a number of forms by growing the conidial and ascogenous stages in pure culture. They collected the spores of *Glœosporium* from different hosts and produced the ascogenous stage. They could not distinguish any morphological differences, though, probably, as the hosts were so diverse, they are likely to be physiological species. The fungi experimented with were collected from the vine, apple, cranberry, rubber-plant, locust, *Ginkgo*, cotton, and bean.

Hyphomycetes.*—G. Lindau has just issued another fascicle of his work. It is mainly occupied with those genera that have brown 1-septate spores, the Phæodidymeæ, which are divided into Bisporeæ, Cladosporieæ, and Cordaneæ. The genus *Cladosporium* claims most attention; the author has recognised 67 species. Some of them are parasites, but most are saprophytic on various plant-remains.

Mycology at the School of Pharmacy.—G. Bainier† reports on the method of preparing blue cheese by allowing a piece of bread to become a mass of blue mould, and then crumbling some of it into the milk. He urges the necessity of a more exact study of the moulds used industrially, and proceeds to describe exactly, and with accompanying figures, 10 new species of *Penicillium* collected from various sources—on potato, dead branches, nettle stems, etc. The author lays particular stress on the character of the vegetative hyphæ as aids in diagnosis. He cultivated the species, and describes the method of growth, germination of spores, etc. A new genus of Hyphomycetes, *Graphiopsis*, is also described and figured. It differs from *Graphium* in so far as the fertile hyphæ are dilated at the extremities and bear a number of conidia. He calls the new form, which grew on rotten wood, *G. Cornui.*

Bainier ‡ found other fungi than *Penicillium* on cheese, one of the most frequent being *Sporendonema Casei*, which he redescribes and figures. He also takes occasion to describe two new species of the same genus, *S. Salicis* and *S. Artemisiæ*, found the one on dead willow stems, the other on dead branches of *Artemisia.*

Still another new genus of Hyphomycetes has been discovered by the same worker.§ *Pœcilomyces*, near akin to *Penicillium* and *Aspergillus*, and bearing long chains of spores, but differing in the manner of branching. The plant *P. Varioti* takes a number of growth-forms, all of which are figured.

Spegazzinia Ornata Sacc.‖—E. A. Bessey describes in detail this member of the Tuberculariеæ Dematreæ, with its two kinds of conidia: (1) smooth, rather small, conidia, borne at the tips of short conidiophores, and (2) spiny, cruciate, large conidia, borne on elongate hyphæ. Cultures were made, and, in varying conditions, one or other of the spore forms alone was produced. No other fruit form was produced. The illustrations show the different conidia and their germination.

Ustilago Maidis.¶—Chifflot has demonstrated the presence of this fungus in the adventitious roots of *Zea Mays*. This plant produces the

* Rabenhorst's Kryptogamen Flora, Band i. Abt. 8, Lief. 104 (Leipzig, 1907) pp. 753–832.
† Bull. Soc. Mycol. France, xxiii. (1907) pp. 9–22 (4 pls.).
‡ Tom. cit., pp. 23–5 (1 pl.).
§ Tom. cit., pp. 26–7 (1 pl.).
‖ Journ. Mycol., xiii. (1907) pp. 43–5 (1 pl.).
¶ Comptes Rendus, cxliv. (1907) pp. 766–8.

roots at the lower internodes of the stalk at the time of flowering, if the plants bear female flowers. The fungus developing in the soil attacks these roots, and prevents them from growing in a normal manner or from entering the soil. It thus causes hypertrophy of the tissues, and induces a dichotomy at the apex.

Uredineæ.—Fr. Bubak * has examined and compared the Pucciniæ that grow on *Carlina acaulis*, *C. vulgaris*, and *C. longifolia*. He finds two fungi differing in form and size: one found on *C. acaulis*, the other, which he names *Puccinia divergens*, grows on the other two *Carlina* species.

F. L. Stevens † describes a new *Puccinia* found on *Melothria*, a genus of Cucurbitaceæ; it is interesting on account of the small number of rusts in that natural order. It is one of the Leptopucciniæ.

W. Tranzschel ‡ publishes a note of his experiments with Uredineæ during 1906. He affirms previous results, and records new facts as to the hosts of several *Pucciniæ*.

W. H. Moreland § discusses the relation of the weather to rust on cereals. He finds that the weather in October influencing the seed-bed is not a determining factor, but humidity in January has much to do with the prevalence of rusts.

L. H. Pammel ‖ has published full accounts of the cedar apple fungi and apple rust in Iowa. The red cedars and apple were alternate hosts of *Gymnosporangium macropus*, and both were badly attacked. He gives an historical account of *Gymnosporangium*, and passes on to consider the different species that grow on pines and alternately on members of the apple order of plants. He gives the results of many inoculation experiments with different varieties of cultivated apples. He advises the removal of cedar-trees from the neighbourhood of apple orchards. The paper is well illustrated.

W. Tranzschel ¶ publishes a series of notes on Uredineæ under 12 different headings, each one dealing with separate inoculation experiments and observations. He found that *Uromyces Caricis* var. *sempervirentis* was connected with *Æcidium Phyteumatis*, *Puccinia Cynodontis* with *Æcidium Plantaginis*; *Puccinia Isiacæ* on *Phragmites communis* produced *Æcidia* on a very large number of plants in many different natural orders, and æcidiospores on *Cerinthe minor* inoculated *Agropyrum trichoporum*, forming uredo- and teleutospores. Also in Turkestan *Æcidia* on *Inula grandis* were found to correspond with a *Puccinia* on *Phragmites*.

Polyporus vaporarius.**—Josef Schorstein records the finding of very strong *Rhizomorpha* on a railway sleeper with a black cuticle, and internally the colour of wood. He cultivated it on oak and obtained the fructification of *Polyporus vaporarius*.

* Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 56–8.

† Bot. Gazette, xliii. (1907). ‡ Ann. Mycol., v. (1907) p. 32.

§ Mem. Dept. Agric. India, i. No. 2 (1906) pp. 53–7. See also Bot. Centralbl., civ. (1907) p. 416.

‖ Exper. Stat. Iowa St. Coll. Agric. Ames Iowa, Bull. 84 (1905) 36 pp. (11 figs.).

¶ Trav. Musée Bot. Acad. Imp. Sci. St. Petersbourg, iii. (1906) pp. 37–55. See also Bot. Centralbl., civ. (1907) pp. 502–3.

** Ann. Mycol., v. (1907) pp. 46–8 (2 figs.).

New Amanita.*—Ph. Riel describes this new Agaric very near to the well-known fly-agaric *Amanita muscaria*, but differing in the shape of the spores, which are round, in the absence of any yellow colouring under the cuticle, and in the strong nutty odour. It differs, too, in the colour of the pileus, being at first of a creamy yellow, becoming somewhat purplish grey, and finally dark sooty-brown. The species is named *Amanita Emilii*.

New Genus of Gastromycetes.†—The fungus was collected by Le Rat in New Caledonia, and has been named by N. Patouillard *Le Ratia similis* g. et sp. n. It grows about an inch in height, of a stalked pyriform shape, and of a dull red colour. The pyriform head has a thin peridium, the interior is a mass of small chambers lined with basidia. The spores are ovoid and slightly coloured.

Yeast-forming Fungi.‡—The first of these, *Cryptococcus salmoneus*, was extracted from gastric juice. It was cultivated on a variety of media, and tested in various ways. No ascospores were formed. A second fungus, *Oidium lactis*, was also thoroughly studied by the same worker, A. Sartory. This fungus is blamed for causing rancidity in butter, and damaging cheese. Sartory gives the results of his various cultures and experiments; he did not find that the *Oidium* caused any harm to animals in which it was inoculated.

Some Injurious Fungi found in Ireland.§—T. Johnson ascribes the prevalence of fungal parasites in Ireland to the heavy rainfall and the water-logged condition of much of the land. With better drainage, conditions will be improved and plant diseases should be less common. He has written a popular account of some of the more prevalent forms of harmful fungi. Yellow blight of Potato has been regarded as due to *Sclerotinia sclerotiorum*: Johnson finds that the mischief is caused by a *Bacillus*, *B. phytophthorus*; he gives the reasons for holding this opinion, and recounts his observations and experiments on the disease. Other parasites of potatoes which he describes are: *Spongospora Solani*, causing scabs and allied to *Plasmodiophora*, *Phellomyces*, *Rhizoctonia*, and *Fusarium*, all causing disease of the tubers. Advice is given as to the best methods of storing tubers. Mangel heart-rot is caused by *Phoma Betæ*, of which the perfect form is *Mycosphærella tabifica*. It is doing great harm in Ireland. The American gooseberry mildew is described, and advice given as to the best methods of treating it. The disease is also attacking the red and black currants and the raspberry. Johnson considers that Government action is necessary to cope with the disease.

Some other diseases are briefly referred to: smut and barley "leaf-streak" (the latter caused by *Helminthosporium gramineum*) and barley-grain black spot. The black spots are due to groups of the dark-coloured conidia of a Hyphomycete *Alternaria tenuis*. The paper is illustrated by photographic plates.

* Bull. Soc. Mycol. France, xxiii. (1907) pp. 1–8 (1 pl.).
† Tom. cit., pp. 50–2 (1 fig.). ‡ Tom. cit., pp. 28–49 (9 figs.).
§ Econ. Proc. Roy. Dublin Soc., i. (1907) pp. 345–70 (4 pls.).

Value of Spraying for Plant Diseases.*—It is only the more delicate leaf diseases that can be combated by spraying methods, but the most widely prevalent and deadly fungi rank in this category. W. Kelhofer has a long series of experiments with different compositions for spraying against *Peronospora*, and he finds that Bordeaux mixture with an excess of lime is by far the best; that it adhered better to the leaves during rainfall, and that it had very damaging effects on the fungi. He found also that the injury to the host-plant was reduced to a minimum.

Disease of Firs.†—L. Mangin and P. Hariot had occasion to examine leaves of firs that had died, taking on a reddish colour, and easily noted in the midst of the green living leaves. They found on these leaves four fungi: *Rhizosphæra Abietis* g. et sp. n., one of the Sphæropsideæ, distinguished by the form of the perithecium; the spores are simple and hyaline. Another new genus, *Menoidea*, one of the Tuberculariaceæ, was also diagnosed; the spores are lunulate-arcuate, simple and hyaline. The other fungi were *Macrophoma Abietis* sp. n. and *Cytospora Pinastri*. The writers came to no definite conclusion as to the cause of the disease, though they are inclined to the belief that *Rhizosphæra*, as the most wide-spread, was probably the origin and cause of the malady. All the new forms are illustrated in the text.

Plant Diseases.—O. Appel ‡ has experimented with *Merulius lachrymans* to determine whether it ever grew as a parasite. He infected seedlings of various trees with the mycelium, without any result.

E. de Wildeman § has examined coffee-plants on the Congo, and finds that the fungus diseases most to be feared there are *Pellicularia Koleroga* and *Hemileia vastatrix*. The latter is not wide-spread on the Congo. A number of new fungi were found on coffee-plants, but their economic significance is not known.

E. S. Butler ‖ gives an account of the fungus diseases of sugar-cane in Bengal, treating them in order as stem diseases and leaf diseases. One of the most serious diseases is caused by *Colletotrichum*, which attacks the stem. The fungi are fully described, and advice given as to treatment of the diseased canes.

A beginning has been made in the study of plant diseases in the Rocky Mountain region, and I. H. Pammel ¶ gives an account of some of those that occur most frequently. *Peridermium* is a most destructive parasite of Conifers, three species of the genus being common in the country. *P. cerebrum* causes malformations on *Pinus Murrayana*, *P. elatinum* gives rise to witches'-brooms on species of *Picea* and *Abies*, and *P. abietinum* produces birds'-nest distortions also on *Abies*. The ravages due to *Exoascus* and *Taphrina* are described, and the mildews of plum and cherry due to Erysipheæ. The writer also includes an

* Zeitschr. Pflanzenkr., xvii. (1907) pp. 1–12.

† Bull. Soc. Mycol. France, xxiii. (1907) pp. 53–68 (9 figs.).

‡ Arb. Kais. Biol. Anst. Land. Forstw., v. (1906) pp. 204–6 (2 figs.). See also Ann. Mycol., v. (1907) p. 105.

§ Comptes Rendus, cxlii. (1906) p. 1093. See also Ann. Mycol. v. (1907) p. 107.

‖ Mem. Dept. Agric. India, i. No. 3 (1906) pp. 1–50. See also Bot. Centralbl., civ. (1907) p. 477.

¶ Iowa Acad. Sci., 1905, pp. 89–114 (6 pls.).

account of the damage done to trees by parasitic Loranthaceæ. They are very injurious to the timber, causing it to become brown and brittle and unfit for lumbering purposes.

The same writer* gives an account of "some unusual fungus diseases in Iowa during the summer of 1903." These are mainly diseases of fruit trees, due to *Cylindrosporium Padi* on the cherry, *Glæosporium Ribis* on the gooseberry, *Cladosporium carpophilum* on plums, etc. Interesting notes are given on the appearance of certain diseases in some localities and not in others, for which climatic conditions do not wholly account, though a comparison of weather reports over a number of years proves the influence that rain and dew have on the spread of fungi.

E. Salmon † tells the story of the outbreak of gooseberry mildew in this country, and his attempts to get gardeners to stamp it out, and also to get Government prohibition against the importation of diseased plants. He deduces from the facts brought forward by him the necessity there is for an international bureau of plant pathology.

Paul Lorauer ‡ in a note emphasises this need of concerted action, and of some centre to which all outbreaks of disease should be notified, and all observations as regards climate and soil, the condition of the host-plants, etc.

L. Hiltner § reports on plant pathology in Bavaria for the year 1905, and he notes the prevalence of *Peronospora viticola*, and the increasing maladies of fruit-trees caused by *Monilia*. *Sclerotinia Trifoliorum* on clover was wide-spread, and was especially severe on foreign varieties of plants. Methods of combating disease are also discussed.

F. W. Dafert and Karl Kornauth ‖ give a similar account of plant diseases in Austria. They notify a further spread of *Plasmopara cubensis* on cucumbers. Cherries suffered from *Coryneum Beijerinckii*, apples from *Fusicladium* and *Monilia*, and pears from *Gymnosporangium*. New parasites from Austria were *Coniothyrium Fuckelii* on roses, *Valsa salicina* on willows, *Hercospora Tiliæ* and *Coryneum pulvinatum* on lime-trees. These latter tree-fungi have been previously regarded as saprophytes.

In Norway during 1904 there was no great epidemic either of insects or fungi, but W. M. Schözen¶ notes as new for the country *Macrosporium melophthorum*, which attacked cucumbers and melons in the hot-houses. Fungi were also recorded as doing damage to fruit-trees, currants, and gooseberries. Roses were attacked by *Sphærotheca pannosa* and *Peronospora sparsa*, the latter new to Norway.

L. Lewton-Brain ** has published a lecture on Rind disease of the sugar-cane, which was delivered to the Hawaiian Sugar Planters' Associa-

* Contr. Bot. Dep. Iowa State Coll. Agric., No. 23 (1904) pp. 147–54.

† Zeitschr. Pflanzenkr., xvii. (1907) pp. 12–20. ‡ Tom. cit., pp. 20–1.

§ Ber. Tätigk. k.B. Agrik. Anst. München, Possenbachen, 1906. See also Zeitschr. Pflanzenkr., xvii. (1907) pp. 33–6.

‖ Ber. Tätigk. k.k. Landw. Chem. Versuchst. Bakt. Pflanz. Schutzst, 1905 (Wien, 1906). See also Zeitschr. Pflanzenkr., xvii. (1907) pp. 36–8.

¶ Beretn. Skadeins. Plantesygd., 1904, Land-og Havebrug (Kristiania, 1905) 26 pp., 17 figs. See also Zeitschr. Pflanzenkr., xvii. (1907) pp. 38–40.

** Rep. Exper. Stat., Hawaiian Plant. Assoc. Honolulu, H.I., 1907, vi. and 38 pp., 16 figs.

tion. The disease is caused by a species of *Melanconium*. The author describes the tissues of the cane, and explains the manner in which the fungus penetrates the cells and vessels and destroys the life of the host-plant. The effects of the fungus are first visible in the leaves—they begin to dry up and turn yellow; then discoloured patches appear on the outside of the stalks, which show the location of the fungus. The fungus is a wound parasite, having gained entrance usually by the puncture of some insect. In a short time the whole cane dies, or its juices are so exhausted that it is practically useless from the sugar-planter's point of view. Lewton-Brain recommends the destruction of diseased canes and the cultivation of varieties resistant to rind disease.

In a recent leaflet issued by the Board of Agriculture,* the alarming gooseberry disease is again dealt with. It is stated that the disease has rendered the cultivation of gooseberries unprofitable wherever it has appeared. Nurserymen and gardeners are specially cautioned to be careful, in the buying of new plants, to receive a guarantee of health from the growers or dealers, and then to plant the new stock in a special area at some distance from other gooseberry bushes. They are also advised to destroy all bushes that have been infected, and to spray those that are liable to any risk of infection. A suitable solution for spraying is given: 1 oz. lime of sulphur (crude potassium sulphide) to two or three gallons of water. The leaflet on the subject can be obtained from the Secretary, 4 Whitehall Place, S.W.

Fungi of certain Termite Nests.†—The nests examined and described by T. Petch are those of ground-inhabiting ants, in which fungi have been found. They have not yet been noted in the nests of the ants that inhabit trees. The ant-hill is first described; it looks like a huge bath-sponge, with chambers and tunnels formed of particles of earth covered with saliva by the ants; and the fungus grows on a comb which consists exclusively of the excreta of the termites. A mycelium covers the comb, and at intervals occur little bunches or spheres of hyphæ. They are formed of branching hyphæ, bearing either spherical or oval cells; the latter germinate readily, but do not reproduce the spheres. On old nests an agaric grows, a modified *Volvaria*. *Xylaria* stromata are produced from the comb, probably *X. nigripes*. Other fungi have been cultivated on comb from the nests, such as *Mucor*, *Thamnidium*, *Cephalosporium*, and *Peziza*. As they are never found in the nest, it is presumed that the ants weed out all such foreign fungi. Petch is of opinion that the "spheres" form the food of the termite ants, as the so-called fungus "cabbages" form the food of the leaf-cutting ants. An account is given of the flight of the ants in an appendix. The paper is well illustrated by photographic plates and drawings.

Gravity as a Form-stimulus in Fungi.‡—Heinrich Hasselbring tested the influence of gravity in determining the form of fungi, by growing them attached to the horizontal axis of a klinostat and rotating them. In some species there was no growth, in others the results were

* Board of Agric. and Fisheries, Leaflet No. 195 (1 pl. and 1 fig.).
‡ Ann. Roy. Bot. Gard. Peradeniya, iii. part 2 (1906) pp. 185–270 (16 pls.).
† Bot. Gazette, xliii. (1907) pp. 251–8 (3 figs.).

of considerable interest. In general, he found in the Basidiomycetes that, although gravity has no apparent effect on the organisation of the hymenophore, it has a marked influence in determining the configuration of the fruit-body of some forms. This effect was most marked in primitive forms. In highly-differentiated forms such as *Coprinus* no formative influence of gravity could be observed. The organisation of the fruit-body depended largely on internal causes, or on stimuli not sufficiently understood.

Flora Italica Cryptogama.*—A second part of this work, continuing the description of the Pyrenomycetes, has been issued by Traverso. The Sphæriaceæ are divided according to spore forms into Allantosporæ, Hyalosporæ, and Phæosporæ. Twenty-eight genera with their species are described, and each genus is illustrated by figures in the text.

Fungi from Northern Latitudes.†—E. Rostrup has worked out the fungi collected by H. G. Simmons on the second Norwegian Polar Expedition, 1898–1902, on the 'Fram.' He makes a list of 80 species, most of them from Ellesmere Land. They are nearly all parasitic or saprophytic on Phanerogams. Eight species are new to science.

BONDARZEW, A. S.—**Die pflanzlichen Parasiten der Kultivierten und wildwachsenden Pflanzen, gesammelt im Gouvernement Kursk in den jahre 1901, 1903–5.** (Plant parasites on wild and cultivated plants from Kursk.)
[319 species of fungi are listed, some of them new to science, and notes are given on various forms.]
Acta Horti Petropolitani, xxvi. (1906) pp. 1-52 (Russian).
See also *Bot. Centralbl.*, civ. (1907) pp. 412–13.

BUBAK, FR., & J. E. KABAT—**Sechster Beitrag zur Pilzflora von Tirol.** (Sixth contribution to the fungus flora of the Tyrol.)
[A list is given of 38 species of microfungi, two of them new to science.]
Ann. Mycol., v. (1907) pp. 40–5.

BURLINGHAM, GERTRUDE SIMMONS—**Some Lactarii from Windham's County, Vermont.**
[The topography of the county is described, and diagnoses are given of six new species, with a list of all the *Lactarii* found in the county, and a key to the species.] *Bull. Torrey Bot. Club*, xxxiv. (1907) pp. 85–95.

CRUCHET, DENIS—**Champignons algues.** (Phycomycetes.)
[An account of filamentous fungi (Phycomycetes) parasitic on Phanerogams, collected between Yverdon and the Jura, particularly at Montagny.] *Bull. Soc. Vaud. Sci. Nat.*, xlii. (1906) pp. 335-44.

DIETEL, P.—**Uredineen aus Japan.**
[The list of Uredineæ collected by S. Kusano, N. Nambu, and T. Yoshinaga, contains several new species, with notes on critical forms.]
Ann. Mycol., v. (1907) pp. 70–7.

EICHELBAUM, F.—**Beiträge zur Kenntnis der Pilzflora des Ostusambaragebirges.** (Contributions to a knowledge of the fungus flora of the mountains of East Usambara.)
[A list of East African fungi, which contains several new species and one new genus, *Agariochæte* (Basidiomycete).]
Verh. Nat. Ver. Hamburg, Folge 3, xiv. (1903) 92 pp.
See also *Ann. Mycol.*, v. (1907) p. 95.

* Soc. Bot. Ital., ii. fasc. 2, Rocea S. Casciano, 1907, pp. 353–492 (28 figs.).
† Report Second Norwegian Arctic Expedition, No. 9 (Kristiana, 1906) pp. 1–110. See also Bot. Centralbl., civ. (1907) pp. 501–2.

KOSTYTSCHEW, S.—**Ueber die Alkoholgärung von Aspergillus niger.** (On the alcohol fermentation of *Aspergillus niger*.)
[A series of experiments as to the growth and production of CO_2 by the fungus in sugar solutions.] *Ber. Deutsch. Bot. Gesell.*, xxv. (1907) pp. 44–50.

HÖHNEL, F. VON—**Mykologisches. XVI. Zur Pilzflora des Niederösterreichischen Waldvjertels.** (The fungus flora of Lower Austria.)
[Notes are given along with many of the species, as to habitat, etc.]
Oesterr. bot. Zeitschr., lvi. (1906) No. 11, pp. 437–40, and No. 12, pp. 461–72. See also *Bot. Centralbl.* civ., 1907, pp. 414–15.

MAYOR, EUG.—**Contribution à l'Étude des Urédinées de la Suisse.** (Contribution to the study of the Uredines of Switzerland.)
[A list of species collected in the Valais in the summer of 1906.]
Bull. Herb. Boiss, ser. 2, vi. (1906) pp. 1012–16. See also *Bot. Centralbl.*, civ. (1907) p. 523.

MORGAN, A. P.—**North American Species of Agaricaceæ. The Melanosporæ.**
[A synopsis is given of the group, and the species of *Psathyrella* and *Panæolus* described.] *Journ. Mycol.*, xiii. (1907) pp. 53–62.

NEGER, F. W.—**Ein Beitrag zur Pilzflora der Insel Bornholm.** (Contribution to the fungus flora of the Island Bornholm.)
[Special attention is given to parasitic forms.]
Bot. Tidsskr., xxvii. (1906) pp. 361–70. See also *Ann. Mycol.*, v. (1907) pp. 96–7.

PECK, CHARLES HORTON—**New Species of Fungi.**
[Twenty new species are described, most of them belonging to the Agaricaceæ.] *Bull. Torrey Bot. Club*, xxxiv. (1907) pp. 96–104.

REHM, H., & RICK, J.—**Novitates Brasilienses.**
[Diagnoses of new species.] *Brot.*, v. (1906) pp. 223–8. See also *Ann. Mycol.*, v. (1906) pp. 97–8.

REHM—**Ascomyceten exs. Fasc. 38.**
[There are a number of new species in the list, which includes fungi from all parts of the world.] *Ann. Mycol.*, v. (1907) pp. 78–85.

RICKER, P. L.—**Third Supplement to New Genera of Fungi.**
[Citations and original descriptions are given, and the lists kept up to date.]
Journ. Mycol., xiii. (1907) pp. 63–7.

RICK—**Fungi austro-americani. Fasc. V.–VI.**
[A list of 40 species, two of them new to science, from South America.]
Ann. Mycol., v. (1907) pp. 28–31.

ROSTRUP, E.—**Bornholm's Svampe.** (Fungi of Bornholm.)
[A list is given of 265 species collected by Neger.]
Bot. Tidsskr., xxvii. (1906) pp. 371–9. See also *Ann. Mycol.*, v. (1907) p. 97.

SACCARDO, P. A.—**New Fungi from New York.**
[The fungi were collected by C. E. Fairman in New York State, and they are all microfungi.] *Journ. Mycol.*, xiii. (1907) pp. 45–8 (6 figs.).

SPEGAZZINI, C.—**Mycetes argentinenses. Ser. IV.**
[A series of fungi belonging to the Gasteromycetes, most of them new. There is one new genus, *Cypellomyces*.]
Ann. Mus. Nac. Buenos Aires, xvi. (1906) pp. 25–33 (4 figs.). See also *Ann. Mycol.*, v. (1906) p. 98.

STEVENS, F. L.—**List of New York Fungi.**
[They were collected in Onondago County, New York.]
Journ. Mycol., xiii. (1907) pp.67–72.

STUDER, BERNH.—**Die Pilzsaison 1906 in der Umgegend von Bern.** (The fungus season 1906 in the neighbourhood of Bern.)

[Notes on the occurrence and growth of various fungi in a specially dry season.] *Schweiz. Wochenschr. Chemie Pharm.*, No. 50 (1906). See also *Bot. Centralbl.*, civ. (1907) p. 523.

WILSON, GUY WEST, SEAVER, & F. JAY—**Ascomycetes and Lower Fungi.**

[A list, in some cases with descriptions of the first fascicle, containing 25 species of exsiccati of fungi the authors propose to issue.] *Journ. Mycol.*, xiii. (1907) pp. 48–52.

Mycetozoa.

Synopsis of the Orders, Genera, and Species of Mycetozoa.*—Since the publication of the British Museum Catalogue in 1894, a considerable number of genera and species have been recorded, and A. and G. Lister have prepared a new synopsis, including all the new forms that have come under their own observation. A bibliography is appended of publications bearing on the subject.

Lichens.

(By A. LORRAIN SMITH.)

Lichen Distribution in the Santa Cruz Peninsula.†—The Californian territory included in this survey is about ninety miles long and thirty-five broad at the widest part. It ranges from sea level to a height of 3793 feet, and presents a great variety of situation, maritime and alpine, rock and forest. It is found that alpine temperate and tropical species are all mingled, while some genera are remarkable by their absence. No species of *Graphis* or *Stereocaulon* has been found, and no specimen of *Cladonia rangiferina*. The writer, Albert W. C. T. Herre, gives lists of the most conspicuous forms found in the different biological areas. He has in his herbarium 200 named species and sub-species from the Santa Cruz region, with perhaps a hundred more not yet satisfactorily determined.

Notes on Cladonia.‡—Bruce Fink has selected *Cladonia degenerans* and some allied species for examination, and reports on the difficulty in determining the different forms and of referring the many varieties to their proper affinities. He remarks that in the present state of knowledge of the genus, "it is impossible to place the *Cladonias* all in any probable continuous genetic series."

COUDERC, G., & J. HARMAND—**Notes lichénologiques: Espèces et localités nouvelles de Collemacées.**

[New species and new localities of Collemaceæ.] *Bull. Soc. Bot. France*, liii. (1906) pp. 238–9. See also *Ann. Mycol.*, v. (1907) p. 116.

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* Journn. Bot., xlv. (1907) pp. 176–97.
† Bot. Gazette, xliii. (1907) pp. 267–73.
‡ Bryologist, x. (1907) pp. 41–5 (2 figs.).

Schizophyta.

Schizomycetes.

Heredity in Micro-organisms.*—M. A. Barber has endeavoured to study the origin and characteristics of new races, by obtaining from the offspring of single varying cells new races of yeast and bacteria. The results of the author's work on *Saccharomyces anomalus* show that continued selection of cells of more than average size does not permanently modify the type. Variations apparently independent of the immediate conditions of cultivation do occur in this species, which can give rise to races endowed with characteristics differing from those of the type. The cells of the new races arising from these variations are abnormally elongated, tend to adhere in groups, and have partially lost the power to produce spores; these characteristics have persisted in cultures in various media for 3 years and 5 months, the new race successfully competing with the parent stock when mixed with it in cultures. Attempts to further modify the new races, or to bring them back to the type, have failed. The new races have greater power of resisting heat and drying, they ferment sugars rather more strongly, and liquefy wort gelatins less than the type.

Similar variations arise in cultures of *B. coli*, apparently independently of the conditions of cultivation; they have tendencies to diminished rate of growth, to the production of long filaments, and loss of motility. These new races vary in the degree of their deviation and in their stability. One new race exhibits an increasing power of fermenting sugars, and a partial loss of sensitiveness to agglutinating serums. The experiments on *B. typhosus*, though incomplete, show that varying cells occur which, when isolated, produce new races, but of comparatively less stability.

The author only obtained one successful experiment on *B. megatherium*, from which he concludes that asporogenous races of bacteria may be obtained by selection of certain vegetable cells, and that these races retain their characters for some weeks.

Aerobic Life of the Tetanus Bacillus.†—G. Rosenthal describes three stages of the tetanus bacillus on assuming aerobic life; at first it retains intact its chemical, biological, and pathogenic characters; later these properties are lost, but may be regained by anaerobic cultivation; in the final stage the distinctive characters of the organism become irretrievably lost.

Bactericidal Action of Wines.‡—J. Sabrazès and A. Marcandier examined the bactericidal action of various French wines on *B. typhosus* of Eberth. The authors found that this action was considerable, and varied in rapidity with different wines, and depended not on the percentage of alcohol, but on the amount of acid, especially sulphurous acid, present in the wine; the action also varied with the dilution of the wine, and with the number of bacilli present.

* Kansas Univ. Sci. Bull., iv. No. 1 (1907).
† C.R. Soc. Biol. Paris, lxii. (1907) p. 578.
‡ Ann. Inst. Pasteur, xxi. (1907) p. 312.

Epizootic Exophthalmia of Fish.*—C. Terni finds that this disease originates from an intestinal intoxication caused by *Bacillus collogenes*, belonging to the Mucogenes group. The pathogenic action of the bacillus shows itself in the presence of albuminoid medium, with the production of a quantity of slime and toxins, which in fish creates severe disturbances in the circulation. The lesions of the eyeball and neighbouring parts which occur in this disease of fish explain many facts that are also observed in man in cases of metastatic ophthalmia, and which are regarded as of true autotoxic origin.

Bacteriological Diagnosis of Rhinoscleroma.†—Schilling found non-virulent diphtheria bacilli in the nasal secretion of a case of ozæna and rhinoscleroma, but never observed the rhinoscleroma bacilli; an histological examination of the soft palate and subglottic folds showed not only rhinoscleromatous tissue, but rhinoscleroma bacilli resembling the pneumobacillus of Friedlander.

Variation in Pigment-production by Micro-organisms.‡—R. Caminiti has studied the pigment-production by *B. prodigiosus*, *Sarcina aurantiaca*, *B. pyocyaneus*, certain streptothrix organisms, and other chromogenic bacteria. The author finds that the intensity of the pigment produced will vary directly with the percentage of glycerin present in the medium.

Specific Bacteria in Ventilating Pipes, etc.§—W. H. Horrocks has shown by a number of experiments that specific bacteria in sewage may be ejected into the air of ventilation pipes, inspection chambers, drains and sewers, by the bursting of bubbles at the surface of the sewage, by the separation of dried particles from the walls of pipes, chambers and sewers, and probably also by the ejection of minute droplets from flowing sewage. A disconnecting trap prevents the passage of bacteria in sewer air into the house drainage system. An air inlet, even when provided with a mica valve, may be a source of danger when placed at or about the ground level.

Fixation of Nitrogen by Azotobacter chroococcum.‖—R. Greig Smith has isolated from a nodule of the Blue Lupin, a slime-producing colony which proved to be a mixture of bacteria; of these the chief slime-producing organism was the *Azotobacter chroococcum*. The author found that the amount of slime produced was greater, and the fixation of nitrogen quicker and more regular, with the mixed culture than with the pure culture of the *Azotobacter*.

Fixation of Nitrogen by Rhizobium leguminosarum.¶—R. Greig Smith finds that races of *Rhizobium leguminosarum* can fix atmospheric nitrogen in artificial culture, and that the fixation is coincident with and proportional to the formation of slime; under conditions that preclude the formation of slime, there is no fixation; the presence of another

* Centralbl. Bakt. Ref., 1te Abt., xxxix. (1907) p. 629.
† Tom. cit., p. 582. ‡ Op. cit., xliii. (1907) p. 753.
§ Proc. Roy. Soc., Series B, lxxix. (1907) p. 255.
‖ Proc. Linn. Soc. New South Wales, xxxi. (1906) p. 616.
¶ Tom. cit., p. 608.

bacterium assisting the formation of slime, also assists fixation. The author found it was a matter of indifference whether the medium is acid or alkaline. All bacterial slimes are nitrogenous, and contain soluble albumenoids. There is a symbiosis between the bacterium and the plant. The plant supplies saline and saccharine matters, the latter of which the bacterium converts into gum, and at the same time elaborates atmospheric nitrogen into constituents that are contained partly within the bacterial cell and partly in the gum, which by virtue of their presence appears as a slime. The nitrogenous and carbohydrate constituents of the slime are elaborated by the plant-cells into tissue elements.

Leptothrix racemosa.*—F. Vicentini describes the morphology of this organism. It occurs on the teeth, and consists of two main portions, a lower felty or alga-like base, and an upper fungoid layer carrying aerial hyphæ with "fruitful heads." The author infers that the organism is of the nature of a lichen, though he classes it among the higher bacteria. It possesses the property of fragmenting into small particles, and the author suggests that *Leptothrix racemosa* is the parent of all mouth bacteria.

Tick Fever.†—C. Levaditi and J. Roche, studying the mechanism of the crisis of tick fever which occurs on the 4th–5th day after peritoneal inoculation of the virus, find that the destruction of the spirilla does not depend on bacteriolysins, or on opsonic qualities of the serum, which properties only appear after the disappearance of the spirilla, and seem to be the consequence rather than the cause of their destruction. It was not possible to determine in what form the parasite persisted during the resting phase; microscopic examination was negative, but mice inoculated with heart-blood and with emulsions of various organs all became affected.

The authors showed that anti-bodies, spirillolysins, and thermostable opsonins appeared in the blood 16–48 hours after the crisis; these bodies acted on the spirilla in vitro, rendering them immobile and agglutinated, transforming them into granules, and making them more ready to be phagocyted. But with the relapse of the fever, living and virulent spirilla are present. This research showed that whereas the anti-bodies persist without modification, the spirilla have been subjected to change which enables them to resist the bacteriolytic and opsonic activity of these anti-bodies; so that the successive reproduction of the treponema is probably due not to the temporary disappearance of the anti-body, but to the immunisation of the parasites against the anti-body.

Opsonic Properties of Normal and Specific Serums.‡—C. Levaditi and Inmann find that the opsonic power of normal serums is due to the intervention of the complement, and slightly also to that of the ambo-ceptor normally contained in these serums. The authors refer to the fact that the aqueous humour of a rabbit, from a first puncture of the anterior chamber, has no opsonic power, does not coagulate, and shows no figured elements, whereas the humour that forms 2–3 hours after-

* Dental Era, v.–vi. (1906) p. 617; and 1907, p. 1.
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 619 and 815.
‡ Tom. cit., pp. 683–869.

wards, at a second puncture, has more or less coagulability, and possesses an appreciable amount of complement. They found that the opsonic power increased proportionately with the bacteriolytic complement. The fluid of œdema produced by ligaturing a rabbit's ear is free from complement if free from blood, showing that the complement does not exist free in the circulating plasma. The polymorphonuclear blood-cells elaborate the bacteriolytic complement, but extracts of these leucocytes have no opsonic properties.

The normal opsonin is identical with the complement; as this complement does not circulate in the plasma, it must be assumed that its opsonic properties do not play an important part in the defensive processes of natural immunity.

The opsonic properties of specific serums obtained from animals vaccinated against pathogenic bacteria, differ from those of normal serums in being thermostable; and whereas when *B. typhosus*, staphylococcus, or *B. dysenteriæ* are placed in contact with a normal fresh serum, the microbe absorbs not only the opsonin that acts on this microbe, but also those that influence the other two; if the experiment is repeated with a specific serum (anti-typhoid serum), the opsonin is only taken up by the microbe which has served for the specific immunisation (*B. typhosus*).

The authors consider that the opsonins of specific serums have a complex constitution analogous to that of bacteriolysins and hemolysins, and are allied to amboceptors.

The opsonising serums only exaggerate more or less the phagocytosis that can occur, although slowly, without their intervention.

Human leucocytes are more sensitive to the action of opsonins than the leucocytes of the rabbit or guinea-pig. The phagocytosis and sensitiveness to opsonins of a microbe increase with the age of the culture. Opsonins produce a physico-chemical alteration in the microbial envelope, so rendering the organism more able to be phagocytosed; this alteration is analogous to that which precedes agglutination, and is independent of the vitality of the bacteria.

Bacillus fæcalis alcaligenes.*—W. N. Klimenko finds that the *B. fæcalis alcaligenes* is closely related to *B. fluorescens nonliquefaciens*; it differs from *B. typhosus* in having flagella only at the ends of the rod, whereas *B. typhosus* is peritrichous, and in the production of alkali on Petruschky's medium, and on medium containing mannite, whereas *B. typhosus* produces acid under similar conditions.

New Species of Thread Bacteria.†—D. Ellis describes a new thread bacterium, to which he has given the name of *Spirophyllum ferrugineum*. The body of the cell is elongated, flattened, and spirally twisted; the width varies from 1–6 μ, and the length may be 200 μ or more; the edge of the cell is thickened, and the ends are irregular; the majority have a spiral length 3–4 times greater than the width. The organism has only been found in iron-water, and, excepting the youngest stages, is coated with a thick deposit of ferric hydroxide. It multiplies by the

* Centralbl. Bakt., 1te Abt. Orig., xliii. (1907) p. 755.
† Proc. Roy. Soc. Edinburgh, xxvii. (1906–7) p. 21.

budding off of conidia in large numbers. The conidia are oval, measuring 1 μ by 1·75 μ. After rupture of the spore membrane, the freed vegetable-cell exhibits a faint motility.

The author considers that this organism, from a phylogenetic point of view, serves to connect the iron bacteria, Leptothrix, Galionella, Cladothrix and Crenothrix, with the genus Spiromonas.

Bacillus nitrator, B. azotofluorescens, and B. hiltneri.* — H. Kaserer describes some new autotrophic nitrogen bacteria. One of these, *B. nitrator*, converts ammonia directly into nitrates. It is a long, moderately thick bacillus, which forms dense white colonies, and does not liquefy gelatin.

B. azotofluorescens decomposes ammonium formate into nitrogen and formic acid, and then utilises the formic acid; in the absence of combined nitrogen it produces ammonium carbonate from formic acid and atmospheric nitrogen.

B. hiltneri decomposes cyanides with production of nitrogen and carbon-dioxide, and also fixes free nitrogen in presence of sugar.

* Zeitschr. Landw. Versuch. Oesterr., pp. 37–4. See also Journ. Chem. Soc., xci.-xcii. (1907) abst. 2, p. 381.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Old Microscope by Cary.—The old Microscope by Cary, with Varley stage (fig. 68), was presented to the Society by Mr. A. W. Waters and

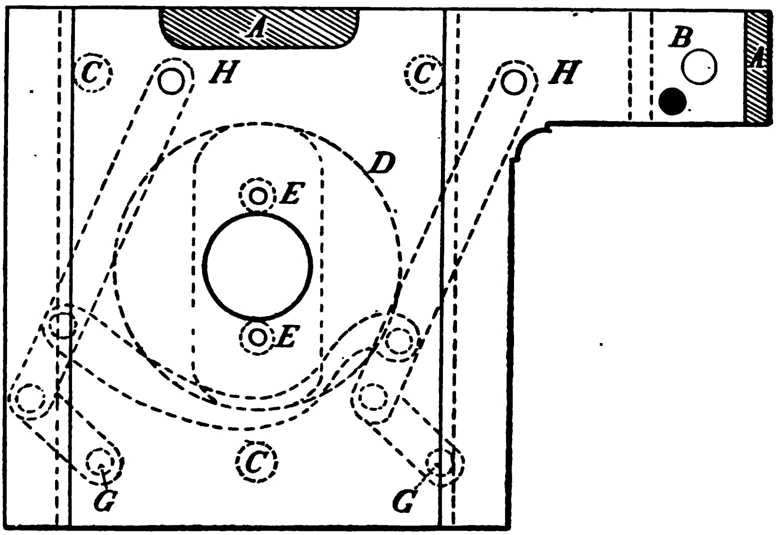
Fig 68.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

his sister, Miss Celia Waters at the October Meeting, 1902.* It is mounted on a brass tripod-foot, with circular pillar, having joint for inclination.

The coarse-adjustment is by rack-and-pinion, attached to the stage. which moves up and down a square bar; the latter also carries the mirror, which is of a concave form, in gymbal.

There is no fine-adjustment, but the arm carrying the body is provided with rack-and-pinion, which moves from back to front, and as the whole is mounted on a rotating centre, the body can be brought to almost any part of the stage.



EXPLANATION OF FIG. 69.

A. Lower plate.
B. Lever giving motion to upper plate.
C. Three studs, to keep plates apart.
D. Circular disk, held up to underside of stage by screws E, and which acts as a spring and also holds the plates together.
G. Two fixed points upon which the levers turn.
H. Studs screwed into upper plate, and by means of which the movement is obtained.

The most interesting part of this old Microscope is the lever-mechanical stage, engraved "Varley and Son." It consists of two parallel plates, the upper one being moved in any direction by aid of a long lever which extends almost down to the foot; a diagram of the parallel motion is given above, with explanatory note (fig. 69). The upper plate of the stage carries a sliding plate with V-shaped fittings,

* See this Journal, 1902, pp. 721 and 722.

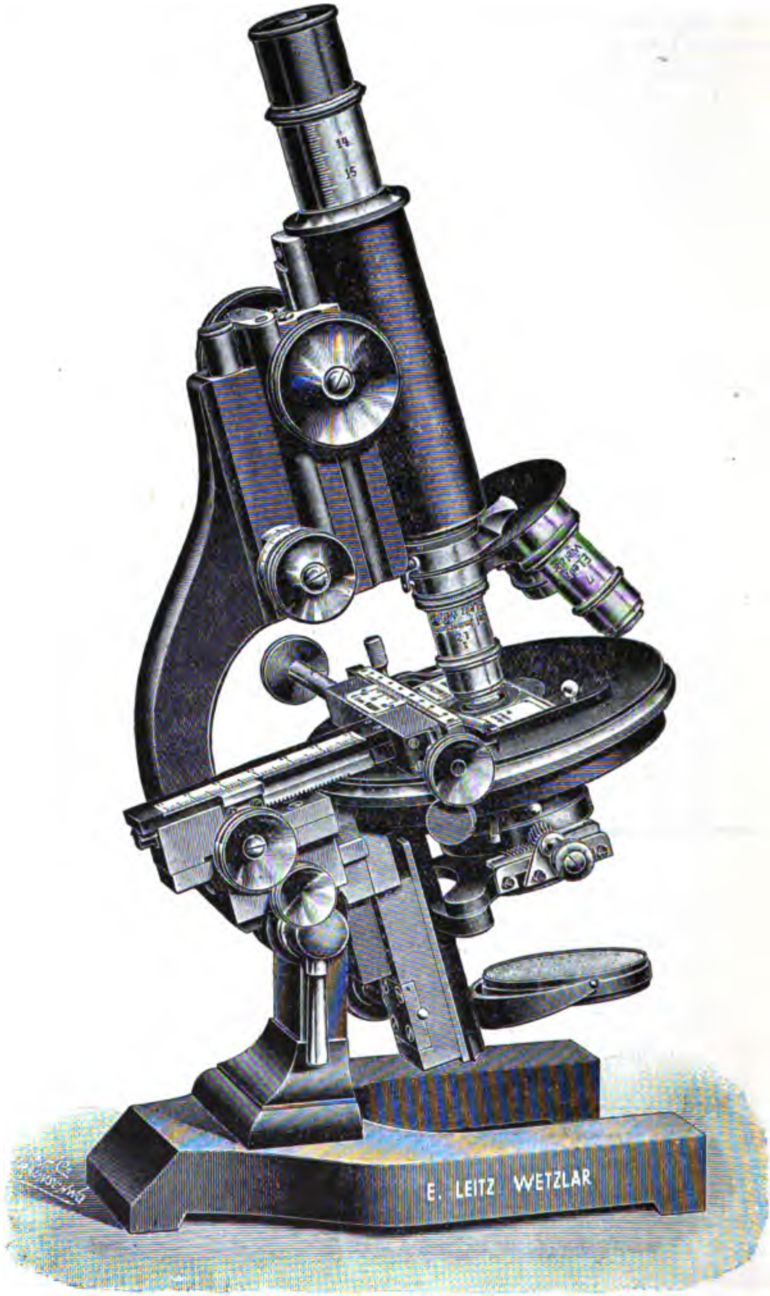


FIG. 70.

and the whole of the mechanical stage can be removed by unscrewing two clamp-screws.

Included in the mahogany case are three objectives, one eye-piece, two live boxes of round form, two stage forceps, and a stand condenser.

Leitz Microscope Stand B.* — This large model (fig. 70) differs from the stand A † in having a horse-shoe instead of a tripod foot. It has the Leitz new form of attachable stage with greatly extended mechanical motions. It is inclinable with hinged joint and clamping

FIG. 71.

lever. The micrometer screw-head of the fine-adjustment is graduated in divisions of $\frac{1}{1000}$ mm. It is fitted with a swing-out substage condenser and iris diaphragm.

Leitz Portable Microscope.‡—This instrument (fig. 71) is the same as the Leitz auxiliary laboratory stand, but is specially adapted for

* E. Leitz' Catalogue, No. 41, English edition, 1905, pp. 28–9.
† See this Journal, 1903, p. 665.
‡ E. Leitz' Catalogue, No. 41, English edition, 1905, pp. 52–4.

travelling purposes, as it takes asunder so as to fit into a comparatively small case (fig. 72). The case serves as a foot for the Microscope, which is provided with a conical pin fitting into a bush in the lid of the case. The stage is provided with a wheel diaphragm, and the upper part of the case is made to slide so as to reduce the size of the case.

FIG. 72.

Recent Improvements in Leitz Microscope Stands.*—Carl Metz discusses several improvements which E. Leitz has applied to Microscopes, designed for the more refined requirements of medical and botanical research.

Stand II*b*, which is still the simplest available for the purposes of bacteriologists, was introduced in 1895, and has recently been improved, the tripod having been replaced by a more graceful and rigid foot of the horseshoe type (fig. 73). This instrument, besides forming an excellent student's Microscope, has frequently enabled those engaged in research to procure a suitable Microscope in cases where the means for a larger and costlier stand were not available.

The new stands (fig. 74), C, D, and F, differ from the older type mainly by the application of a micrometer screw of a new form. The screw is attached to the body of the Microscope immediately behind the tube, and transmits its motion to a slide carrying the tube. The new micrometer movement met with so much favour that the original inten-

* Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 430–9 (5 figs.).

tion of adapting it to the medium-sized stands was promptly carried into effect. By reason of the transposition of the fine-adjustment to the

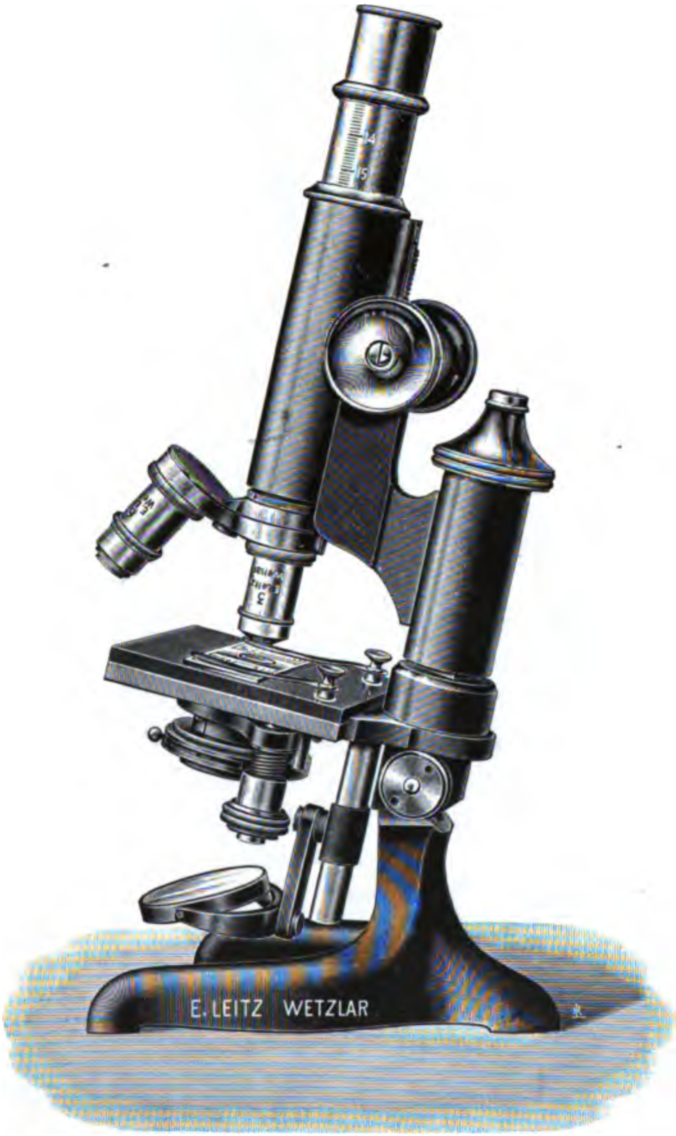


FIG. 73.

front of the body, the micrometer screw, unlike that of the continental stands, is relieved of the weight of the upper body and the tube

Fig. 74.

carrier, and accordingly it became possible to construct a more delicate movement.

Fig. 75 is a vertical section through the mechanism of the new fine-adjustment. The essentially new element of the movement is a heart-shaped cam *f* composed of two symmetrical and equal parts of a spiral curve. The spirals are of that simplest order in which the distance of the periphery from the centre of rotation increases in the same ratio as the angle of rotation. The maximum change in the peripheral distance amounts to 3 mm. The heart-shaped piece is mounted upon a tooth-wheel *d* in such a manner that its centre of rotation coincides with that of the tooth-wheel. The tooth-wheel is actuated by an endless screw *a*, which is controlled by the two milled heads projecting from the sides of the body. A spring *b* exercises a constant pressure upon the screw-spindle and the tooth-wheel, and thus eliminates play, even when the motion is reversed. The rise and fall of the spiral is transmitted by a

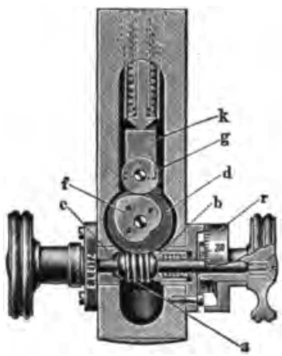


Fig. 75.

roller *g* upon a carrier *k*, which, being rigidly attached to the sliding piece, communicates its motion to the tube. The roller and spiral are kept in permanent contact by the weight of the tube and the spring situated above the roller and depressing the latter. An elevation of 3 mm. of the roller and consequently of the tube is produced by half a rotation of the tooth-wheel, i.e. a rotation of the cam from the point to the base. The tooth-wheel having 60 teeth must accordingly be turned through 30 teeth. Rotation through one tooth thus gives rise to an elevation of the tube amounting to $3/30 = 0 \cdot 1$ mm. The displacement of one tooth is effected by one complete revolution of the worm-screw *a* and its milled head. The drum is mounted upon the screw spindle and divided into 100 equal parts. The rotation of the drum through one division corresponds accordingly to an elevation of $\frac{0 \cdot 1}{100} = 0 \cdot 001$ mm.

In addition to the delicacy and slowness of the movement which is attainable with this screw, it possesses several other advantages. Owing to the association of two symmetrical spirals, so as to form a continuous

cam, the motion is of the nature of an endless rotation, producing a reciprocating motion of translation as alternately one or the other spiral comes into play. The movement encounters no check in either direction, and consequently there is no possibility of injuring the mechanism by rotation beyond any fixed limit.

The movement possesses the further advantage that it effectively guards against the destruction of a cover-glass and an object, since any excessive depression of the tube would merely cause the objective to gradually rest upon the cover-glass, whilst the cam detaches itself from the roller without, however, exerting any mechanical pressure upon the cover-glass, which with rare exceptions will readily bear the weight of the tube with its optical and mechanical appendages.

Immediately after its first description the micrometer movement was criticised,* and the criticism has been reiterated on p. 66 of the present volume of 'Zeitschrift für wissenschaftliche Mikroskopie,' the objection having been raised "that an observer working with this movement was never certain whether the tube was rising or falling, and that uncertainty of this nature was likely to become a serious impediment in ordinary ocular observation no less than in photo-micrography."

If this objection could be sustained, surely Leitz would ere this have removed the supposed defect. It is not difficult to recognise the reason why the maker and the thousand and one workers who already use this mechanism fail to admit the validity of this criticism. As a matter of fact, every practised microscopist focuses an object with a fair degree of accuracy by the rack-and-pinion only, and passes on to the fine-adjustment when he has obtained a pretty distinct image of his object. He then turns the micrometer screw in one or the other direction without experiencing any curiosity as to whether he is raising or lowering the tube, being quite content to obtain the sharpest possible adjustment in a minimum of time. The process is quite analogous to that occurring in other optical instruments requiring a fine adjustment, i.e. in telescopes, photographic lenses, optical lanterns, etc., where the observer is solely concerned in obtaining a sharp image, whereas the direction in which the mechanism moves does not interest him in the least.

In very special cases, e.g. when examining the substance of a thick preparation, an observer may consider it desirable that rotation of the coarse- and fine-adjustment in one direction should carry the tube in the same direction. In such a case he may with the aid of the two fixed marks in the tube-carrier and a movable index on the slider easily ascertain the direction in which the tube is moving. By giving the screw spindle a few turns in the same sense the direction of motion may be recognised at once. If its motion is not in agreement with that imparted by the rack-and-pinion the rotation of the micrometer head should be continued until the two movements become equidirectional. If, moreover, the movable index be placed midway between the fixed marks, it will be a long time before a change of direction occurs, since 30 complete turns of the drum are available before the motion reverses.

The introduction of the new micrometer screw and its transposition to the front of the column have brought with them several improvements

* See this Journal, 1903, p. 665.

in the general design of the Microscope, besides a few advantages which have been secured. The arching of the limb affords not only a convenient handle, whereby the stand may be grasped, but provides also an increased working space on the stage. The stands of this type, thanks to the precision of the new micrometer movement, have within a short time secured such a large measure of popularity as to create the impression that they are gradually supplanting Microscopes of the older type. It would seem that the creation of these new models, by associating the mechanical and optical qualities of German Microscopes with the elegant design of the English models, signalises a new era in the construction of Microscopes.

Leitz Large Mechanical Stage.*—This apparatus (fig. 76), adapted for the Leitz stands A, B, C, D, has very extensive lateral and vertical movements, which are effected by rack-and-pinion.

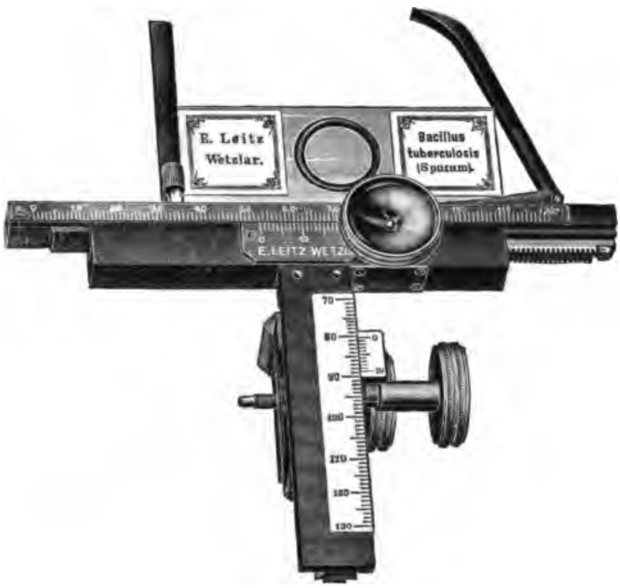


FIG. 76.

Ettles-Curties Ophthalmometer and Ophthalmic Microscope.—This instrument (fig. 77) is provided with a telescope having two objectives well corrected for chromatic and spherical aberrations, and of unusually large working aperture: between these two objectives a Wollaston double-image prism is placed.

The eye-piece is of the Ramsden type, and has a spider web fixed in a set plane. The operator focuses this web and then knows that the

* E. Leitz' Catalogue, No. 41, English edition, 1905, p. 89.

deviation on which the accuracy of registration depends is absolutely fixed.

The arc is of stout brass, concentric with the cornea under observation. It can be rotated around the polar axis of the eye so that any meridian can be observed. A transparent goniometer is attached to the telescope, also pointer and means of sighting to set telescope and insure the images of the mires being within the field of the eye-piece. The arc

FIG. 77.

carries two symmetrically moving lanterns, or "mires," which are set in motion by rotating a single milled head engaging a double rack. Each mire contains an electric lamp, and one has a stepped stencil, the other a parallelogram with cross-line; the latter carries a red glass and the former one of green tint. The stepped mire is divided into six steps, each of which is exactly equal to one dioptre of curvature. The arc is graduated with two scales, one in half dioptres from 30 D to 60 D, and the other showing the actual radius of curvature of the cornea expressed in mm., from 5·5 mm. to 9 mm. A small mirror attached to arc admits of the scales being read from the eye-piece end of the telescope.

The face-holder has a chin-rest capable of being raised or lowered, and is marked on either side with two white lines indicating the position the patient's outer canthi should occupy.

The instrument is made in two forms, one mounted on a table stand, as illustrated, and the other with a tripod floor-standard on castors. The upright of the stand contains a helical spring which counter-balances the superincumbent weight and facilitates the adjustment of the instrument to the height of the patient's canthi. The whole of the upper part of the instrument can be removed and the ophthalmic Microscope or any other apparatus substituted.

The ophthalmic Microscope (fig. 78) consists of a body with draw-tube and R.M.S. gauge for objective and eye-piece.

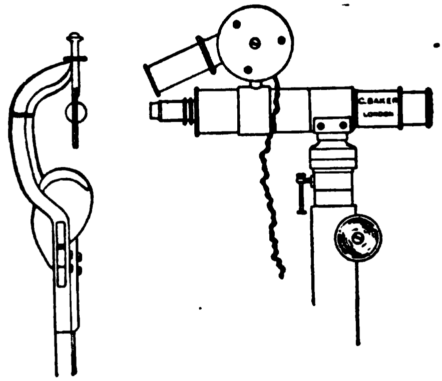


FIG. 78.

The electric illumination is inclosed in a cylinder and mounted on the body in such a manner as to admit of free orientation. It is provided with a condenser, adjustable to give either a parallel beam or a converging pencil, and has also a carrier for tinted glasses.

Objectives ranging from 3 in. to 1 in. can be employed.

DIECK, W.—**Das Photomikroskop für ultravioletten Strahlen und Seine Bedeutung für die histologische Untersuchung.**
SB. Ges. Naturf.-Freunde, Nos. 1–5, Berlin, 1905.

(2) Eye-pieces and Objectives.

Measurement of Highly Curved Lenses with the Abbe Spherometer.*—H. C. Lomb shows that the formula usually applied, viz.:

$$R = \frac{r^2}{2h} + \frac{h}{2}$$

is not sufficiently accurate for highly curved lenses. (Here R = required radius of curvature; h the lens thickness as measured by the instrument;

* Deutsch. Mech.-Zeit., 1907, pp. 15–17 (2 figs.).

r the arithmetical mean of the radii r_1 r_2 of the inner and outer edges of the circular holder.) In such cases a closer value of R is got from

$$R = \frac{r_1^2 + r_2^2}{4h} + \frac{h}{2} + \epsilon \quad . \quad . \quad (1)$$

R is first approximately calculated from the formula by omitting ϵ, that is from

$$R = \frac{r_1^2 + r_2^2}{4h} + \frac{h}{2}$$

The value of R, so obtained, is then substituted in—

$$\epsilon = \frac{(\sqrt{R^2 - r_1^2} - \sqrt{R^2 - r_2^2})^2}{8h}$$

Then the value of ϵ is substituted in (1), and the final value of R so obtained. The revised formula gives a result differing by 1·5 p.c. from that obtained from the ordinary formula.

Leitz Photographic Objectives with Iris Diaphragm.*—These new formula objectives (fig. 79) were designed for the Edinger, the

FIG. 79.

photomicrographic and projection apparatus of 64, 42, 35, and 24 mm. focal distance, and have proved useful for a number of purposes.

HALL, J. J.—**The Magnifying Power of Eye-pieces.**
English Mechanic, lxxxv. (1907) Nos. 2200–2.

(3) Illuminating and other Apparatus.

Demonstrating the Pseudo-vacuoles of Yeast-Cells.†—J. J. van Hest, after referring to the difficulty of illuminating yeast-cells and bacteria by any other than transparent light, describes how a kind of incident illumination can be attained by a process of lateral action. Under ordinary circumstances parallel light impinging on the mirror is reflected upwards through the condenser, and the rays cross before entering the objective. The object is therefore illuminated on all sides

* E. Leitz' Catalogue, No. 41, English edition, 1905, p. 11.
† Centralbl. Bakt. Parasitenk., xvii. (1906) pp. 94–5.

from below, and the light, if too strong, may be reduced by help of a circular diaphragm with a central orifice. But if this diaphragm be replaced by an opaque circular disk, out of whose margin a small circular segment has been removed, as shown in fig. 80, then only oblique rays will pass through the object. The result is that the convergent action of the objective procures a lateral and downward view of the object. The author obtained his best effects with a Zeiss objective C, and compensation oculars 8–18.

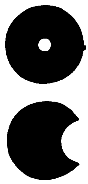


FIG. 80.

Zeiss Dark Ground Illumination by Stopping-off in the Immersion Condenser.*—The firm of Carl Zeiss have designed this apparatus for the convenient examination of living bacteria, blood-tests, and serum-tests. The method adopted is to insert a star-shaped disk into the diaphragm of the Abbe illuminating apparatus. The little central knob of this disk projects upwards, and upon it is accurately placed a central disk of 24 mm. diameter; the diaphragm-holder is then clamped. During this process the iris has been fully open. The entire fitting is now swung into position. In the majority of cases arc-light illumination would not be required.

Measurement of Light-absorption by means of Rotating Prisms and Motionless Sectors.†—E. Brodhun describes, under the above title, a species of photometer for the accurate determination of the loss of intensity suffered by a beam of light in passing through a given solid or liquid substance. The apparatus is so contrived that the percentage of light thus absorbed is read off on a graduated scale.

Achromatic Illuminator.‡—Percy Dunn describes an achromatic illuminator for examining the surface of the eye, and other similar purposes. The apparatus (fig. 81) consists of an achromatic lens

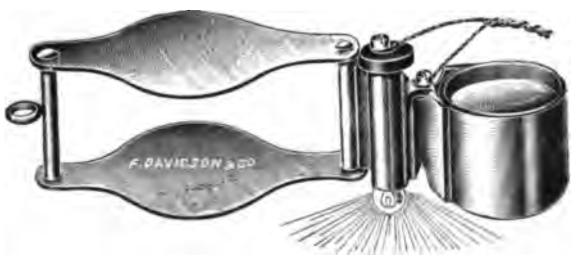


FIG. 81.

of about $\frac{1}{2}$ in. focus fixed in a metal clip, attached to which is a lamp-holder for an electric light. The current is controlled by means of a spring, by pressing which the light is turned on. The lamp is of

* Special Catalogue, Jena, 1907
† Zeit. f. Inst., xxvii. (1907) pp. 8–18 (8 figs.).
‡ Lancet, 1907, i. p. 1718 (1 fig.).

4 volts, and is screwed into the holder. A dry battery is supplied, which with intermittent use may last for more than 6 months. The apparatus can be fitted with 8- and 12-volt lamps for use with various accumulators, and even with the ordinary house current by means of special adapters. The apparatus is made by F. Davidson and Co.

HEIMSTADT, O.—**Spiegelkondensor für ultramikroskopische Beobachtungen.** *Zeitschr. f. Chem. u. Ind. d. Kolloïde*, Jahrg. 1, 1907, heft 9.

(4) Photomicrography.

Instantaneous Photomicrography.*—C. A. François-Franck gave a demonstration of the results he obtained by means of instantaneous photomicrography and of chronophotomicrography. The objects were taken under magnification varying from 60–600 diameters, and included the movements of the appendices, of the heart and intestines of *Daphnia*, colonies of *Vorticella*, respiratory appendages of the larvæ of *Ephemera*, branchia of *Arenicola*, etc.

LEITZ, E.—**Neuer mikrophotographische Universalapparat.** *Zeitschr. f. wiss. Mikrosk.*, xxiv. (1907) p. 40.

LOWENSTEIN, E.—**Versuche über Dreifarbenmikroskopie.** *Zeitschr. f. Tuberk*, x. (1906) p. 34.

(5) Microscopical Optics and Manipulation.

On the Nature of Optical Images.†—Albert B. Porter draws attention to the want of general recognition that all optical images arise

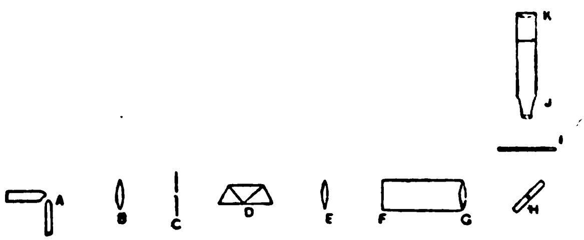


FIG. 82.

by interference, and are, indeed, particular cases of interference patterns, and describes a simple experiment which shows the relation between interference and image formation in a striking manner (fig. 82).

The experiment consists in passing a parallel beam of monochromatic light through a coarsely ruled, black-line, diffraction grating, and then through a convex lens. On the far side of the lens a system of sharply defined interference fringes is formed which can be seen by aid of an eye-piece, or intercepted on a screen, at any point over a considerable range along the axis. Somewhere in this system of fringes is the geometrical image of the grating, but it is visually quite indistinguish-

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 964–7.
† Physical Review, xxiv. (1907) pp. 303–6 (1 fig.).

able from any other transverse section of the fringe system. Clearly in this case, the geometrical image is merely that section in which the geometrical condition of similarity to the object is satisfied.

The best arrangement of the experiment is the following. Light from an arc lamp A is focused by means of the lens B upon a narrow slip C. Thence it passes through a direct-vision prism at D, and the spectrum is focused by the lens E upon the narrow slit of a collimator F G. The parallel beam of monochromatic light thus obtained falls upon the mirror H of a microscope K J, upon whose stage, at I, the grating is placed in such a position that its ruled lines are parallel to the projection of the two slits C and F. Using a black-line grating of 400 lines to the inch, and having both slits narrowed down to a small fraction of a millimetre so as to secure very homogeneous illumination, the field of view was examined with $\frac{2}{3}$-in. objective and 1-in. eye-piece. The interference fringes appeared in the field of the eye-piece with exquisitely sharp definition throughout the whole range of the coarse-adjustment of the Microscope, i.e. over a distance of 58 mm., beginning with the front of the objective in contact with the grating and with its focal plane 7 mm. below the ruled surface; and the fringes could be traced through a much greater range by withdrawing the eyepiece and moving it back along the axis. As the Microscope is slowly focused upward, the bands undergo curious changes in appearance, the lines showing sometimes close together and again further apart, but the definition is almost equally sharp throughout the whole range of adjustment, so that any section of the fringe system is as good an apparent image as any other section. Similar but less perfect effects may be obtained by illuminating the field by means of sodium light passing through a slit a couple of millimetres wide at a distance of one or two metres.

If the angle of the incidence of the light on the grating is changed by moving the mirror, the whole fringe system shifts to one side or the other except in the focal plane, where it remains stationary. This shows (1) that the focal plane is the plane in which the interference fringes formed by light of all incidences coincide; (2) that, when a broad source is used, the geometrical image is really a superposition of coincident interference patterns; and (3) that the usual absence of a sharp image outside the focal plane is due to the more or less uniform illumination resulting from the overlapping of fringe systems due to light coming from various points in the source. When the grating is illuminated by a parallel beam of white light by means of a collimator with very narrow slit, or, less perfectly, by a distant gas flame turned edgewise, the effects are similar except that outside the focal plane the fringes are coloured. Hence (4) the focal plane is also the plane of achromatic interference, i.e. the plane in which the fringes due to light of various wave-lengths coincide.

These experiments show very clearly why it is in general essential to use a condenser to illuminate the field of a Microscope in order to obtain a critical image, i.e. an image which comes sharply into and out of focus and which is hence as free as possible from confusion with details of structure lying above and below the focal plane. It is interesting to observe how, as the illumination is made less homogeneous and more

convergent, the distance through which the interference can be distinguished decreases, and the precision of focusing increases.

In the case of self-luminous objects, although the geometrical image is still to be considered as an interference pattern, the effects outside of the focal plane are greatly modified by the absence of definite phase-relations between the waves emanating from various points.

GLEICHEN, A.—**Leitfaden der praktischen Optik.**
Leipzig: S. Hirzel, 1906, viii. and 221 pp.

(6) Miscellaneous.

Textile Fibres.*—The well-known work of J. Merritt Matthews on the physical, microscopical, and chemical properties of textile fibres has recently passed into a second edition. To the microscopist the microchemical reactions and microscopical appearances and properties of fibres are necessarily the more important topics. These features are prominent, are treated of very fully, and are amply illustrated, mostly from original preparations of the author. The micro-analytical tables, which form a section of the chapter on the qualitative analysis of textile fibres, will be found very useful, not only to the practical operator, but to the amateur.

On the whole the work is fairly well balanced, though cotton receives considerable attention, over one hundred pages being devoted to it. In addition to the text proper, which treats of wool and hair fibres, shoddy, silk, cotton, linen, and other vegetable fibres, are four appendices. These deal with the microscopic analysis of fibres, a machine for determining the strength of fibres, commercial varieties of American cotton, and the bibliography of textile fibres. The volume is well got up, and the illustrations numerous and clear.

Quekett Microscopical Club.—The 440th Ordinary Meeting of the Club was held on May 17, the President, Dr. E. J. Spitta, F.R.A.S., F.R.M.S., in the chair.

A paper by Mr. F. Chapman, A.L.S., F.R.M.S., on "Some Littoral Gatherings of Foraminifera from Victoria, Australia," was read by Mr. A. Earland. The author gives an account of the literature on Victorian Foraminifera, and describes the geology of the localities from which gatherings were obtained. A detailed list of some 103 species is attached. Mr. Earland prefaced his résumé of the paper with some hints on the usual methods of collecting, and some very interesting remarks on the life-history of Foraminifera.

At the 441st Ordinary Meeting, held on June 21, the President in the chair, Mr. C. F. Rousselet, F.R.M.S., read a paper "On *Brachionus sericus* sp. n., and a new variety of *Brachionus quadratus*, and remarks on *Brachionus rubens* Ehrenberg." The new species was first met with in 1895 at Totteridge, and has since been obtained sparingly at other places near London, and also from Dundee and Exeter. In general appearance it resembles *B. urceolaris*.

* New York: John Wiley and Sons; London: Chapman and Hall, 1907, 480 pp., 126 figs.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Cultivating Bacillus fusiformis and Spirochæta dentium.†—P. Mühlens has isolated *B. fusiformis*, from the mouth, in pure culture, on horse-serum agar; the organism grows at 37° C. only on serum or ascitic fluid, or on media containing such fluids, and is a strict anaerobe. After 44–48 hours there appears under the surface of the serum agar fine yellow colonies with darkish centres and star-like projections; there is no production of gas; anaerobic serum bouillon cultures show a flocculent deposit and clear fluid; all cultures have a fœtid odour. There was only slight pathogenicity for laboratory animals.

The author also cultivated *Spirochæta dentium* for several generations together with a bacterium, on both solid and fluid medium; the colonies show after 8–10 days incubation at 37° C.; they are difficult to distinguish, and appear as a yellow clouding of the serum agar; they have an unpleasant penetrating odour; they grow only in the absence of oxygen, and on media containing animal albumen; sugar is not fermented; there is no production of gas; no growth occurs in milk or on potato. Spirochætes survive 4–6 weeks at 37° C. Pathogenicity for animals was not observed.

Bacteriological Diagnosis of Cerebrospinal Meningitis.‡—O. Brian advocates the following method for the rapid diagnosis of cerebrospinal meningitis. From a serum agar culture obtained from cerebrospinal fluid, a loopful is taken and rubbed in the side of a tube holding some of the patient's serum, and also of a controle tube, evenly-clouded fluids resulting. Both tubes are now centrifuged according to Gaehtgen's method for 10–15 minutes; with the serum giving a positive reaction the cocci are deposited as flocculi.

Cultural Characteristics of Tubercle Bacilli.§—J. v. Szaboky finds that the vigour of growth of the tubercle bacillus varies in different media; the best growth is obtained on lung agar, then on sputum agar, sputum-lung agar, and tubercle-lung agar; growth is less vigorous on egg medium, and on somatose agar; growth is best and quickest when the medium is slightly acid, less good if it is neutral or alkaline, and bad if strongly acid. On somatose agar it grows best if the medium is strongly alkaline; on egg medium growth is best when the medium is strongly acid. Growth is most vigorous on moist media like lung agar.

Apparatus for Isolating Micro-organisms.‖—M. A. Barber has devised the following apparatus for the isolating of single micro-

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.

† Centralbl. Bakt., 1te Abt., xxxix. (1907) p. 479.

‡ Op. cit., xliii. (1907) p. 745.

§ Tom. cit., p. 651.

‖ Kansas Univ. Sci. Bull., iv. (1907) pp. 1–48 (3 figs.).

organisms. To an ordinary glass slide are cemented pieces of glass to form a box, open at the top and at one end (fig. 83), the dimensions of the box being 40 by 25 by 18 mm.; the sides are lined with wet filter-paper; a cover-slip 25 by 40 mm., cleaned and sterilised, is placed on the upper edges of the box, previously vaselined. On the under surface of the cover is placed a drop of a nutrient fluid, and near to it a drop of culture containing the organisms to be isolated; the whole is then placed on a Microscope stage; a fine capillary pipette with a curved tip and a brass holder is clamped to the left side of the stage: the box, with its open end towards the pipette, is adjusted so that the cross lines [x] on the cover are in the centre of the field; the pipette is then

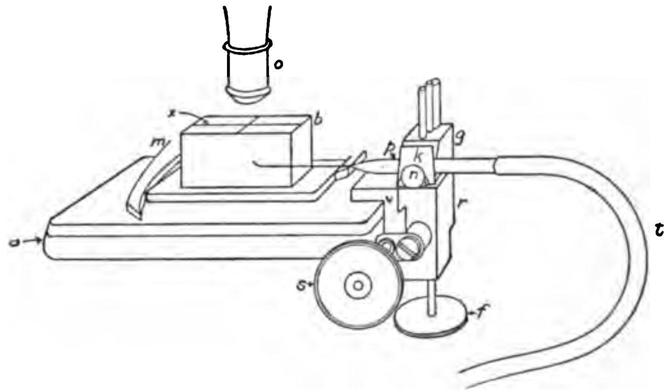


Fig. 83.

adjusted by moving it in the groove at the side of *g*, and by turning the screw *s* that moves the parts *r* and *g* of the holder, until the point is nearly in the centre of the field; the pipette, with the parts *g*, *k*, and *n* holding it, is raised or lowered by the screw *f*, the part *v* being clamped to the Microscope stage.

The portion of the cover bearing the sterile drop of medium is now brought into the field; the tip of the pipette is then raised into it and partially filled; the pipette is then lowered and the culture-drop is brought into the field; the pipette is then again raised until it comes into contact with the micro-organism to be isolated; this at once enters the pipette (often in company with other cells); the cover is then moved by the mechanical stage, until the tip of the pipette can be brought into contact with an unoccupied part of the cover, when its contents are discharged, being blown out gently by means of the rubber tube *t*. The author suggests various modifications to be used in special conditions.

Cultivation of Amœba of Dysentery.*—A. Lesage has found that human dysentery amœbæ, either in the soft or cystic stages, when

* C.R. Soc. Biol. Paris, lxii. (1907) p. 1157–9.

cultivated in the presence of leucocytes (guinea-pig, dog, rabbit, man), not only live but develop, while the leucocytes degenerate. The leucocytic exudate is placed on ice for a day and then centrifuged, and the supernatant fluid used as cultivation medium. Pus from abscess of the liver is sown in the fluid. Intestinal mucus is not very suitable for the purpose, but if necessary, must be injected into the peritoneal sac of a guinea-pig. This gets rid of most of the contaminating bacteria, and the peritoneal fluid may then be used for cultivation. Cultivated in this way, amœbæ have all the known characters of the human parasite.

New Method of Isolating Bacillus typhosus from Infected Water.*—W. J. Wilson describes a new method of isolating *B. typhosus*

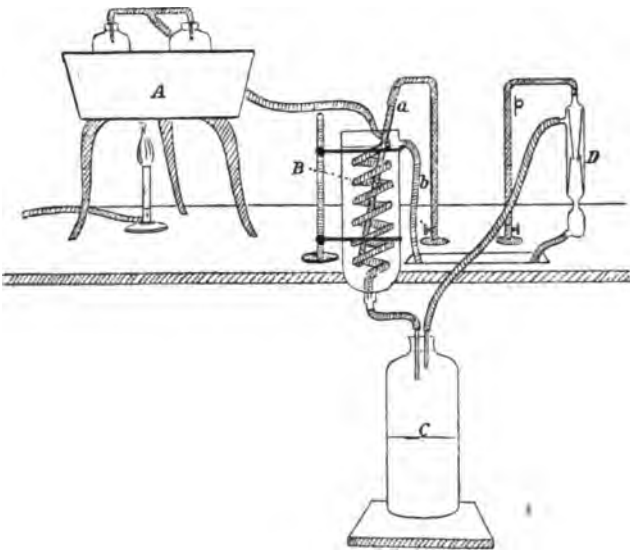


Fig. 84.

(fig. 84) from suspected water, which, according to ordinary standards, might be deemed free from pollution. The principle of the method is to evaporate water under reduced pressure.

A is a water bath maintained at 37–40° C. This temperature can be easily obtained by regulating the height of the flame of the Bunsen burner. No special gas regulator is required, though Reichert's may be used with advantage. In the bath are two Winchester quart bottles containing the water to be examined. Rubber corks fit into the necks of these bottles, and should be so shaped that they will not be driven in when the pressure in the interior of the bottle is reduced. These corks are perforated by glass tubes which project into the interior of the bottles. The surface of the water should be at least 4 in. from the end

* Brit. Med. Journ., 1907, i. pp. 1176–7 (1 fig.).

of these tubes, so as to prevent the water bubbling into them when it begins to boil. These tubes are bent at an angle immediately above the top of the corks. The advantage of an acute bend is that the condensed water finds a suitable gradient towards the worm of the condenser B, with which the tubes are connected by means of a T-shaped glass junction and rubber pressure tubing. Through the glass vessel surrounding the worm there is a continual flow of cold water, entering by the pipe *a* and leaving by the pipe *b*. The worm is connected with a large bottle C, which is also connected with a water filter pump D, which is secured to a pipe *p* coming from the main by means of stout tubing braced with cloth, cord, and wire. By this means a partial vacuum is obtained in the bottles, and the water readily boils at 37° C. The vapour readily condenses, and the distillate is collected in C. It requires 21–22 hours to evaporate a litre of water.

After starting the process it needs no further attention till the end is almost reached, when one should be at hand to stop it at the proper moment.

One filter pump can only deal efficiently with one or two bottles; if more are connected up with it the distillation process is proportionately slowed.

The residual water is plated out on the Conradi-Drigalski medium, and the plates incubated in the usual manner.

Cultivating Meningococcus.*—W. St. Clair Symmers and W. J. Wilson found that the most satisfactory solid culture medium was the following: Raw ascitic fluid 1 part, 3 p.c. agar 2 parts. The agar was made in the usual way, and Chapoteaut's pepton was found to give superior results to Witte's, though the latter was good. In making the medium the agar was allowed to cool to 55° C., and then the ascitic fluid warmed to the same degree was added. Slopes were made. When set the tubes were incubated for 24 hours to test the sterility. For this medium the laboratory name "chapasgar" is suggested.

The authors isolated meningococcus 52 times out of 75 samples of cerebro-spinal fluid, and from the blood of living patients in 3 out of 15 cases. The organism was found to be Gram-negative, did not peptonise gelatin, formed indol, forms acid from glucose and maltose, but not from galactose, does not form gas, grows well in media containing raw ascitic fluid, lives for at least a week in chapasgar, for 2–4 weeks in ascitic bouillon, for 2 weeks to 2 months in fluid sugar media.

R. M. Buchanan,† who has tried various media for cultivating meningococcus, finds that ox-serum after Loeffler's formula (3 parts ox-serum, 1 part bouillon, and 1 p.c. glucose) gives the best results. To this medium neutral red in the proportion of 1 : 10,000 was added as indicator. Meningococcus thrives well, and assumes a pink tint. On plating out meningococcus colonies are easily detected, and their indication is further corroborated by means of serum-sugar media (glucose, galactose, maltose, saccharose). Acid is formed in the glucose, galactose,

* Brit. Med. Journ., 1907, i. pp. 1477–9.
† Lancet, 1907, i. pp. 1590–1.

and maltose media. In the glucose tubes the condensation water is fluorescent, and there is also a pus-like appearance of the growth.

The organism retains its vitality in this medium for at least a fortnight.

Collecting and Preserving Thysanura.*—Alma D. Jackson finds that one of the most successful methods for collecting alive, is to introduce the insects (not more than two or three) into capsules, in which is placed a small piece of lense paper to absorb moisture from the insects, and to give them something to crawl over. The capsule may be perforated with a fine pin-point to admit air; it is important to keep the insects alive, as the antennæ and body begin to shrink directly they die. Another method is to use large-mouthed bottles with a funnel in the neck. Pieces of wood, bark, etc., are gently tapped over the hopper, and the insects fall into the bottle, which should be provided with damp wood, leaves, etc., for the animals to crawl over. For fixing the insects in the field, the collector should be provided with a large number of small, round-bottomed phials filled with the fixative, two or three fine camel-hair brushes, a large square of white oilcloth, and a chisel or pick for dislodging bark or decaying wood. The pieces of bark, etc., are pounded over the cloth on which the insects fall. The brush moistened with fixative is placed over the insect, which, when stupefied, is easily removed to the bottle. The following fixative is recommended: Glacial acetic acid 1 part, absolute alcohol 1 part, corrosive sublimate to saturation. This fixes in a few seconds, but specimens may be left on it for hours, and are then transferred to 85 p.c. alcohol or gradually to glycerin as follows: place the specimens on a stentor dish and add glycerin at one side. After a time the cover is removed to allow the acetic acid and alcohol to evaporate.

For preserving the colour, the following fixative has advantages: Glacial acetic acid 10 parts, glycerin 1–4 parts, corrosive sublimate to saturation. After some minutes, the acetic acid is allowed to evaporate, and then the glycerin should be changed frequently to get rid of as much sublimate as possible. Another method is to pour boiling absolute alcohol over the insects previously placed in a straight-necked phial; after from 5 to 15 minutes they are transferred to 95 p.c. alcohol, and finally preserved in 85 p.c. alcohol. The changes between different grades of alcohol should be made about every 10 or 15 minutes. If the insects are to be mounted in balsam, xylol may be added gradually to the absolute alcohol, or, on the other hand, glycerin may be added and the alcohol allowed to evaporate. Cedar or clove oil may be used in place of xylol with less liability to shrinkage.

One of the best methods for examining Thysanura is to transfer specimens which have been in glycerin for some hours to a thick syrup consisting of apple-jelly and glycerin. After an hour or so they are mounted in pure apple-jelly, to which a small quantity of carbolic acid or of corrosive sublimate has been added.

Specimens may also be examined in cedar or clove oil which has been

* Ohio Naturalist, vii. (1907) pp. 119–22.

boiled down to a thick syrup. Such mounts should be ringed round with Bell's cement.

Thysanura is easily kept alive in the laboratory by placing the insects in a straight-necked bottle, at the bottom of which are a few bits of decayed leaves and dirt. Then a piece of decayed wood is gummed tightly in, and by keeping this moist, and the bottle in a dark place, the insects will do as well as in their natural surroundings.

Bacteriological Diagnosis of Typhoid and Paratyphoid Fever.*— It is not universally known that it is possible to obtain pure cultures of typhoid or paratyphoid bacilli, from the blood-clot of patients after removal of the serum used for the Widal reaction. The clot is spread with a glass spatula over a litmus-lactose-agar plate; or the clot may be placed in a test-tube containing fresh ox-bile recently sterilised, and incubated over night. The next day Endo's or Drigalski-Conradi plates are inoculated from the bile tube. It is claimed that in this way the diagnosis of typhoid or paratyphoid fever may be made in the early stages of the disease, when the Widal reaction is slight or negative, and when the bacilli are not usually cultivable from the fæces.

(2) Preparing Objects.

Examining the Undulating Membrane of Spirochæta balbiani.†— A. Borrell and Cernovodeanu find that in the fresh state the undulating membrane is convex, semi-rigid, and striated. Fixed preparations of any value can only be obtained by killing the spirochætes rapidly by means of osmic acid vapour, and fixing the films afterwards with alcohol or other media. The films may then be stained with the gentian-violet-alcohol-formalin solution of Vlès. When examined, the membrane is found to be attached to the body of the parasite in a spiral line which makes one complete turn parallel to the line of torsion of the cell itself. All along the membrane are seen the striations which the authors regard in the light of a supporting framework, and compare it to the ribs of an umbrella.

Studying the Sporangium of Equisetum hyemale.‡—L. A. Hawkins killed the material with the fluid mixture: chromic acid 0·15 grm., acetic acid 0·35 c.cm., water 99 c.cm. The silicious protective leaves were removed before the young strobili were killed; they were then passed through upgraded alcohols and imbedded in paraffin m.p. 60°. Longitudinal sections, 7 μ thick, of the strobili were cut, the younger stages being stained with Delafield's hæmatoxylin, the older with safranin-gentian-violet-orange G mixture.

Studying the Sperm-cells of Notonecta glauca.§—J. Pantel and R. de Sinéty fixed the material in Flemming's or Bouin's fluid; neither gave complete satisfaction at all stages. In order to facilitate orientation

* Lancet, 1907, i., pp. 1241–2.
† C.R. Soc. Biol. Paris, xlii. (1907) pp. 1102–4 (1 fig.).
‡ Ohio Naturalist, vii. (1907) pp. 124–8 (2 pls.).
§ La Cellule, xxiii. (1906) pp. 87–303 (8 pls.).

the organs to be sectioned, while in the supra-vital state, were placed on a slide in a drop of physiological salt solution and washed with the fixative. This insures the organs retaining the position and attitude desired.

In order to examine sperm-cells *in toto*, it was found best to place efferent ducts or the long spiral duct which forms the pedicle of the spermatheca of the female on a slide in salt solution to which saliva was added and then rupture the sheath by exciting moderate traction. This allowed the sperm-cells to escape; after running off any excess of fluid, the filaments were fixed with formol-picro-acetic acid. The authors note that spermatozoa are very sensitive to desiccation, but not at all to the action of reagents.

Most of the preparations were stained with Heidenhain's iron-hæmatoxylin, but some were treated with fuchsin, followed by picro-indigo-carmin or Unna's blue solution.

Studying Spermiogenesis in the Squirrel.*—J. van Mollé fixed the material in Hermann's, Bouin's, Carnoy's, or Gilson's fluids; of these, Bouin's gave the best results. The sections were stained with the safranin-gentian-violet-orange G mixture or with Heidenhain's hæmatoxylin and Congo red. For examining, Beck's oil-immersion condenser and Koristka's apochromatic or semi-apochromatics were used.

Studying Spirochæta balbiani and S. anodontæ.†—H. B. Fantham obtained the material from oysters and from the crystalline style of *Anodonta cygnea*. Much time was spent in examining these spirochætes in the living condition, and as far as possible in their natural medium. For fixed and stained material the best results were obtained from thin smears of gut contents or solutions of the crystalline style (sea-water for *Ostrea*, fresh-water for *Anodon*), the preparations being fixed wet with osmic vapour. Other fixatives used were Flemming's solution, corrosive sublimate, and alcohol, and in the case of dried smears methyl- and ethyl-alcohol. The preparations were usually mounted in cedar-wood oil or balsam. The most useful stains were gentian-violet (Ohlmacher's formula), iron-alum-hæmatoxylin, thionin, Billet's modification of Giemsa and Delafield's hæmatoxylin, while dilute methylen-blue was best for intravitam staining. The results from Romanowsky's stain were indifferent.

Demonstrating the Presence of the Spirillum of Tick Fever.‡—C. Levaditi and Y. Manouélian infected animals—mice, rats, and monkeys—by means of subcutaneous and intra-peritoneal injections. The animals were killed at varying intervals. The organs were fixed in 10 p.c. formalin, or in Gilson's sublimate-acetic acid alcohol. For demonstrating the presence of the spirilla in sections, the silver-pyridine method used for the study of *Treponema pallidum*, was adopted. For examining the details of phagocytosis the following procedure was necessary: Pieces, about 1 mm. thick, of previously fixed tissue

* La Cellule, xxiii. (1906) pp. 1–52 (2 pls.)
† Ann. and Mag. Nat. Hist., xix. (1907) pp. 493–501.
‡ Ann. Inst. Pasteur, xxi. (1907) pp. 295–311 (2 pls.).

(formalin and absolute alcohol) were soaked in water and then immersed in a 1 p.c. solution of tannin, to which pyridine was added in quantity sufficient to redissolve the turbidity. After about a quarter of an hour in this bath at 50°, the pieces were frequently washed in distilled water. The pieces were next placed in a flask containing a 1 p.c. solution of nitrate of silver, to which 10 p.c. of pyridine had been added, and incubated at 50° for an hour. After a wash in distilled water the pieces were reduced in a 4 p.c. solution of pyrogallic acid, to which as much pyridine had been added as served to render the solution clear. Reduction took only a few minntes. Then distilled water, alcohol, xylol, paraffin, and sections; the latter were stained with a combination of neutral red and methyl (*sic*) blue.

Studying the Spermatogenesis of Blatta germanica.* — A. Wassilieff fixed the testicles in sublimate, sublimate acetic acid, Flemming's and Hermann's solutions, all of which gave good results. Carnoy's, vom Rath's, and Rabl's fluids were unsuccessful. Sublimate preparations stained with iron-hæmatoxylin showed the centrosomes well. Mitochondria were excellently shown when iron-hæmatoxylin was used after Flemming's fixative. Magenta-indigo-carmin with picric acid (Ramon y Cajal's method) was extremely suitable for the study of chromosomes. The last-mentioned stain was also effective for centrosomes, but useless for mitochondria. As the sexual glands function throughout the year, all stages in the development of the sexual products were always obtainable.

(3) Cutting, including Imbedding and Microtomes.

Studying the Nucleus and Kinesis in Spirogyra.†—Jules Berghs fixed the material in Hermann's, Bouin's, or in Moll's modification of Flemming's fluid. The material was gathered once in June and once in September, the former at about 9 p.m., the latter at midnight; both collections gave numerous kinetic figures. The different stages in manipulation from the fixative to imbedding in hard paraffin, were very slowly and carefully carried out, a dialyser being used when transferring from aqueous media to alcohol. When the chloroform stage was reached it was found expedient to use soft paraffin at first and gradually work up to hard. Most of the sections were stained with Heidenhain's iron-hæmatoxylin, but some with safranin and light green, as advised by Benda.

Treatment of Celloidin Serial Sections.‡ — Ino Kubo communicates the following procedure. The sections in series are kept till wanted in a glass vessel. Each series is placed on a numbered strip of bibulous paper moistened with alcohol, and this in its turn is inclosed in another piece, which is tied or rolled.

The slides to be used are first marked with a diamond or with Indian

* Archiv Mikrosk. Anat. u. Entwickl., lxx. (1907) pp. 1–42 (3 pls.).
† La Cellule, xxiii. (1906) pp. 53–86 (3 pls.).
‡ Archiv Mikrosk. Anat. u. Entwickl., lxx. (1907) pp. 173–6 (1 fig.).

ink, and then receive two or three thin coats of celloidin. In order to remove a series from the paper strips, it is only necessary to immerse the section in water, when it floats away to the top, and may then be lifted on to the prepared slide, which must previously be moistened with distilled water. When all the sections are arranged, the excess of water is poured or blotted off, and then with two or four folded strips of paper the sections are firmly pressed down into the celloidin layer on the slide. To insure firm adhesion, the slide is dipped in alcohols upgraded from 80 p.c. to 98 p.c., and on removal the sections are smoothed down each time. Lastly, a little ether is brushed over the surface. After a partial drying, the slides may be stained right away, or preserved for future use in 80 p.c. alcohol.

The adhesion of the sections to the slide is so firm that they can be stained with hæmatoxylin, decolorised with hydrochloric-acid-alcohol, and neutralised with ammonia water without the film stripping off, though care must be taken not to make the changes from alcohol to water too sudden, nor should absolute alcohol be used too long for dehydrating. For clearing up, carbol-xylol answers well. About 10 troughs, 12 by 6 by 4 cm., are required for the different fluids. For accurately disposing of the sections on the slide, the author uses a piece of card or glass some 3 by 2 in., with vertical and transverse lines; this is placed under the slide while arranging the sections.

(4) Staining and Injecting.

New Modification of Romanowsky's Stain.*—R. May has devised the following simple method of applying Romanowsky's stain. The preparation is stained in a 0·25 p.c. methyl-alcoholic solution of acid eosin-methylen-blue, and placed for one minute in distilled water; then, whilst still wet, a drop of 0·5 p.c. methylen-azur solution distributed regularly over the specimen; by the action of the methylen-azur the blue nuclear stain is faded and assumes a red appearance.

The method is suitable for staining bacteria and spirochætes.

Studying Oogenesis in Paludina vivipara and Chromidia in Paludina and Helix.†—M. Popoff fixed the material, ovaries of animals at different ages obtained in spring, summer and autumn so as to get all stages of development, in Zenker's, Petrunkewitsch's and in Flemming's fluids. Flemming gave excellent results for nuclei in *Paludina*, but blackened the cytoplasm too much; on the other hand, for *Helix* it was specially good. The preparations were stained with iron-hæmatoxylin, but for deciding the case of the nucleolus they were controlled with Delafield's hæmatoxylin, hæmatoxylin-eosin, hæmatoxylin-acid-fuchsin, Flemming's double stain, Berlin blue, borax-carmin, and gentian-violet. Teased-out preparations stained with borax-carmin and examined in oil of cloves were of great service.

* Centralbl. Bakt. Ref., 1te Abt., xxxix. (1907) p. 582.
† Archiv Mikrosk. Anat. u. Entwickl., lxx. (1907) pp. 43–129 (5 pls.).

Staining Spirilla in Sputum.*—L. Follet makes use of the following mixture: Glycerin 40 grm., acid-fuchsin 2 grm., pure carbolic acid ½ grm. Mix, and filter after solution. The sputum to be examined should be recently expectorated, and preferably after fasting. Pick out a fragment with a platinum needle, place on slide, and add thereto a minute drop of stain. Mix thoroughly and put on a coverslip and examine. If a little acid green dissolved in glycerin be mixed with the sputum before the acid-fuchsin is used, a brownish hue is imparted to the preparation; and if a double-staining be desired, this may be effected by using in addition to the acid-fuchsin solution the following mixture: Glycerin 40 grm., methylen-blue 2 grm., pure carbolic acid 0·5 grm.

While this medium stains all the spirilla infesting the mouth, so that quite swarms may be observed in the same field, there is no difficulty in differentiating *Treponema pallidum*.

Another method given by the author is suitable both for fixed and fresh films. This consists of chloroform 40 grm., methylen-blue 2 grm., acid-fuchsin 0·25 grm., pure carbolic acid 0·5 grm.

The stained preparations must be thoroughly washed in running water, and if need be in alcohol to remove excess of pigment.

Orlean, a New Stain for Cork and Cuticula.†—P. Sonntag finds that Orlean or Annatto, used for dying wool and silk, and for colouring butter and cheese, makes a good stain for cork and cuticula. The reagent used is a solution of Orlean extract (Extract-Orleanæ spirit. spiss.) dissolved in alcohol and filtered. If this solution be applied for ½–1 hour to sections of *Cystisus Laburnum*, which are afterwards washed in alcohol and then placed in water or glycerin, the cork-cells are found to be stained orange-yellow, contrasting with the whiteness of the rest of the tissue.

Modification of Donaggio's Method for Staining Nerve-cells.‡—Andrea Tomaselli treats the material as follows: Pieces of nervous tissue (spinal ganglia) are immersed in ammoniacal alcohol (absolute alcohol 100, ammonia 4–5 drops) for 6–7 hours. They are then immersed in pure pyridine and kept at a temperature of 36–37° C. for two days, the pyridine being very frequently changed, especially at first. The pieces are then washed in running water for 2–3 hours. The after treatment is the same as that in Donaggio's third method, i.e. the material is treated with an acid solution of molybdate of ammonia for 12 hours, imbedded in paraffin, and the sections stained with thionin (1:10,000).

Bielschowsky's Impregnation Method.§—F. K. Studnička obtains excellent results from Bielschowsky's impregnation method when dealing with connective-tissue fibres in bone, dentine, and hyalin cartilage. The procedure is as follows. The method of fixation is quite immaterial, good results being obtained from alcohol, formalin, 4 p.c. nitric acid, Muller's, Flemming's, Perenyi's, Mayer's, Kleinenberg's, and other

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 567–8.
† Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 21–4.
‡ Op. cit., xxiii. (1906) pp. 421–2. § Tom. cit., pp. 414–20.

fluids. The material is decalcified in the usual way, but the author used nitric acid with 3 p.c. alcohol. Both paraffin and celloidin sections can be used. The sections, after thorough washing in water, are placed in 3 p.c. silver nitrate solution for about 4 days. They are then washed in distilled water, and afterwards transferred to an ammoniacal silver solution, prepared as follows: to a 10 p.c. solution of silver nitrate a 40 p.c. solution of caustic soda is added drop by drop until a precipitate is no longer produced. The sediment is then dissolved in ammonia. The slightly yellowish fluid is filtered and made up to four times its bulk with water. In this fluid the sections become darker, and of a yellowish-brown hue. After washing they are placed in 10 p.c. formalin, which turns them brown. After 5 minutes or so, they are washed, and then placed in ½ p.c. gold chloride solution, in which their colour becomes grey to black. They are next transferred to a 5 p.c. solution of fixative soda, which renders them less opaque as some of the unreduced silver is dissolved. Then follows a thorough washing in water, alcohol, oil, xylol, balsam.

The sections may be contrast-stained with advantage, e.g. with acid-fuchsin or with Van Gieson's picric-acid—acid-fuchsin mixture.

Demonstrating the Presence of Negri Corpuscles in Salivary Gland of Mad Dogs.*—Élise Stefanescu fixed the material in formalin and made frozen sections, which were stained by Mann's method (methylen-blue and eosin) modified to suit the requirements of the case. The sections were staining for 20–30 minutes. They were then washed with water, dehydrated in alcohol, cleared up in xylol, and mounted in balsam. The Negri corpuscles were stained red-violet, which easily differentiates them from the blue colour of the cytoplasm.

Studying Sympathetic Nervous System of Mammals.†—A. Kohn used rabbit embryos in his research and fixed the material for 24 hours in the following fluid: 25 c.cm. of 5 p.c. aqueous sublimate solution, 75 c.cm. of 3½ p.c. potassium bichromate solution, 5 c.cm. acetic acid. After washing for 24 hours in running water the material was passed through upgraded alcohols to 95 p.c. alcohol. To this last some tincture of iodine was added, and, after sufficiently iodising the material, was preserved in 95 p.c. alcohol. The material was stained *en masse* with alum-cochineal or with dilute hæmatoxylin, and in the latter case the sections were contrast-stained with picro-fuchsin, eosin, Congo-red, etc. Sections were also treated with Weigert's iron-hæmatoxylin-picro-fuchsin stain and also by Ramon y Cajal's silver method.

Demonstrating the Presence of Striated Muscle in the Thymus.‡—R. Weissenberg killed the fowls with chloroform and fixed the tissue with some preparation of osmic acid, Flemming's strong solution giving the best results. Tellyesnicsky's fluid was also used. Sections 3 μ thick were stained with iron-hæmatoxylin or by means of Bielschowsky's silver method. The sections were mordanted for 4 hours,

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 886–8.
† Archiv Mikrosk. Anat. u. Entwickl., lxx. (1907) pp. 266–317 (3 pls.).
‡ Tom. cit., pp. 193–226 (1 pl.).

stained for 16 hours, and differentiated with iron-alum for 20 seconds only. The correct degree of differentiation was gauged by examining under an oil-immersion.

New Method of Staining the Tubercle bacillus.*—M. Barberio's method consists in staining the film with a solution of magenta and phenol, and afterwards treating it with a dilute solution of nitrous acid, which does not affect the staining of the tubercle bacillus, but decolorises most bacteria owing to the conversion of the basic magenta into a colourless diazo-compound. The preparation is first treated for 25–30 minutes at 40–50° with a mixture of 2 c.cm. of a cold saturated solution of magenta in 96 p.c. alcohol, and 2 c.cm. of a 5 p.c. aqueous solution of phenol. It is then rapidly washed in water and immersed for 10–15 minutes in 10 c.cm. of a dilute solution of sodium nitrite (1 : 20,000) containing a drop of dilute hydrochloric acid (D 1·12). Bacteria, other than tubercle bacilli, can be stained differentially by means of methylen-blue. The preparation is finally washed in water, dried, and mounted in balsam.

Tetrachrome Staining Mixture.†—G. Delamare has devised a four-colour solution for simultaneously staining nuclei and connective, elastic and muscular tissue. It consists of two solutions which are mixed in equal parts. The first is composed of orcein, 1 grm.; hydrochloric acid 1 c.cm., absolute alcohol 50 c.cm.; the second of Ehrlich's hæmatoxylin 2 c.cm., saturated aqueous solution of acid fuchsin 1 c.cm., saturated aqueous solution of picric acid 200 c.cm. The paraffin sections are first immersed in slightly acidulated water, and afterwards in the stain at 45° for 20–30 minutes. On removal they are rapidly washed in acidulated water (4 or 5 drops to 100 c.cm.), and then placed in tap water to bring out the blue of the hæmatoxylin. Then alcohol, xylol, balsam. Nuclei, blue; muscle fibre and protoplasm, yellow; connective-tissue, yellow; elastic fibres, black.

Examining the Sputum in Cancer.‡—L. Follet has found a micro-organism with double contour, and apparently a yeast in the sputum of persons affected by cancer. He stains fresh unfixed films with the following mixture: glycerin, 40; methylen-blue, 2; carbolic acid, 0·5. The ingredients are dissolved and the mixture filtered. In order to obtain permanent preparations he adopts the following procedure: 40 grm. chloroform, 20 grm. liquid ammonia, and 10 grm. of carbolic acid are mixed in a flask, and after a few hours the chloroform is syphoned off, and then to this carbolate of ammonia a gramme of methylen-blue is added; the mixture is then filtered. A film of the sputum to be examined is made in the usual way, and stained without heating; a few drops of chloroform are poured on the film, and when this has evaporated, the slide is washed in running water and afterwards dried with blotting-paper. The films may also be stained with the

* Rend. Accad. Sci. Fis. Mat. Napoli, xii. (1906) pp. 446–9. See also Journ. Chem. Soc., xcxi.–xcxii. (1907) p. 381.
† C.R. Soc. Biol. Paris, lviii. (1905) pp. 828–9.
‡ Tom. cit., lxii. (1907) pp. 790–2.

following mixture: methylen-blue, 2; fuchsin, 0·3; carbolic acid, 0·5; glycerin, 40; distilled water, 20. This imparts a double stain and shows the details well.

The author has found the micro-organisms he mentions more than a hundred times in cases of undoubted cancer, and has frequently been led to diagnose the condition in cases where malignant disease has not been suspected.

(5) Mounting, including Slides, Preservative Fluids, etc.

Euparal, a New Mounting Medium.*—G. Gilson finds that sandarach, or pounce, a resin derived from *Callitris quadrivalvis*, is a valuable basis for mounting media. The principal menstruum is a mixture of camphor and salol, called for short "camsal," which forms a colourless liquid having a refractive index of 1·53576. In this menstruum, sandarach is only slightly soluble, the addition of some alcohol or other solvent being necessary. The two alcohols which were found suitable for the purpose were isobutylic and propylic. The mixture of sandarach, camsal, and propylic alcohol makes a medium having a refractive index of 1·47892.

Isobutylic alcohol was found to have properties more suitable for microscopical technique; thus it is extremely useful for dehydrating delicate objects, and when used as solvent for camsal and sandarach, forms a balsam having a refractive index of 1·47892.

The two foregoing media have the inconvenient defect of dissolving pigments, so that they are practically useless for mounting stained preparations. In a mixture of eucalyptol and paraldehyde, the author found an efficient substitute for the alcohols, and to the mixture of sandarach and camsal with eucalyptol and paraldehyde, he gives the name of "euparal." The refractive index of euparal is 1·48302.

Under the name of essence of euparal, Grübler supplies a mixture for dissolving euparal. This essence is mixed with euparal in the proportions of 1 : 1, or 2 : 1, and is useful in technique, as the preparations can be taken directly from 70° alcohol to the medium. Euparal is stated to possess all the qualities of an ideal mounting medium.

Water-glass for Marking Slides.†—R. F. Griggs describes a method for marking slides which is specially useful for serial sections. The medium is water-glass, aqueous solution of sodium or potassium silicate, thinned if necessary till it will flow well from a pen. A steel pen of the stub or ball-pointed sort is used. After the slides are marked they must be heated by holding them for a few seconds in the blue cone of a Bunsen flame till the water-glass decomposes, giving off strong jets of sodium light, and at the same time effervescing so as to leave behind a rough sandy surface. This is then rubbed down against some hard object, such as a table edge. This leaves a ground-glass surface, which will be unaffected by any reagent. If desired,

* La Cellule, xxiii. (1906) pp. 425–32.
† Ohio Naturalist, vii. (1907) pp. 157–8.

some inert dye, such as carmine, may be stirred into the solution to make the marks more conspicuous.

Mounting Worms in Amann's Lactophenol.*—Langeron killed Nematoda in 5 p.c. formalin, and then gradually substituted for the fixative Amann's lactophenol (carbolic acid 20, lactic acid 20, glycerin 40, distilled water 20), in which menstruum the worms were mounted.

(6) Miscellaneous.

Studying the Plumes of Cephalodiscus.†—W. G. Ridewood studied the development of the plumes in the buds of *Cephalodiscus*, and describes the procedure adopted. In the youngest stages the whole bud was mounted in diluted glycerin, and gold size was run round the edge of the cover-glass to keep it firmly in position and to prevent the glycerin from accumulating dust. Most of the buds were dissected, the shield being first removed by tearing through its stalk by the aid of fine needles, and then the collar region, with plumes and post-oral lamella, was removed by carefully manipulating the needles between these parts and the "body" of the bud. The three parts, shield, collar-region, and "body," with its stalk, were then mounted on the same slide in dilute glycerin. In some cases these three parts were drawn separately on tracing paper, and the perfect bud reconstructed by a superposing of these transparent sheets. No staining fluids were used. The dissections were made under a Greenough binocular erecting Microscope, magnifying 20 to 40 diameters.

Examining the Chromatin-masses of Piroplasma bigeminum.‡—H. B. Fantham fixed and stained the blood-films by Romanowsky's method, and in order to eliminate as far as possible sources of error incidental to stained preparations, the slides were examined under various kinds of illumination. These were (1) critical illumination, using as the source of light the sharp edge of a paraffin flame; (2) monochromatic light (green or yellowish-green was best); (3) light from a Welsbach burner or an electric lamp. Only the first two were useful; while the chromatin could always be distinguished from the cytoplasm of the parasite, very bright white light failed to accurately show the relative sizes of the chromatin masses, there being also a lack of detail. Too strong a light gave wrong impressions as to size and condition of the vacuoles. Daylight was also used. The objectives used were Zeiss' 2 and 3 mm. apochromats, with 8, 12, and 18 oculars. Relatively pale-stained preparations were found to be far superior to more deeply stained ones, as the finer chromatic details and the looser chromatin in the latter are obscured, and the finer structural details masked.

Appliances for Counting Blood-corpuscles, Yeast-cells, Bacteria, etc.§—C. Zeiss and Co. describe their counting chambers and mixing pipettes. The counting chamber is made by cementing a glass plate

* C.R. Soc. Biol. Paris, lviii. (1905) pp. 449–50.
† Quart. Journ. Micr. Sci., li. (1907) pp. 221–52 (11 figs.).
‡ Tom. cit., pp. 297–324 (1 pl. and 44 figs.).
§ Carl Zeiss' Special Catalogue, Jena, 1906.

with a circular aperture upon an object slide, and cementing a smaller plate of less thickness into this aperture. The surface of both plates being parallel and ground accurately plane, the depth of the chamber, or distance between the two surfaces, is regulated by selecting plates of desired thickness. By placing a plane cover-glass upon the outer plate, a plano-parallel cavity, the dimensions of which can be accurately determined, is formed between the cover-glass and the inside plate. This inside plate is ruled with cross-lines by means of which the observer is enabled to successively examine fluids on separate fields, and to count the corpuscles in each. These cross-lines are designed of different forms

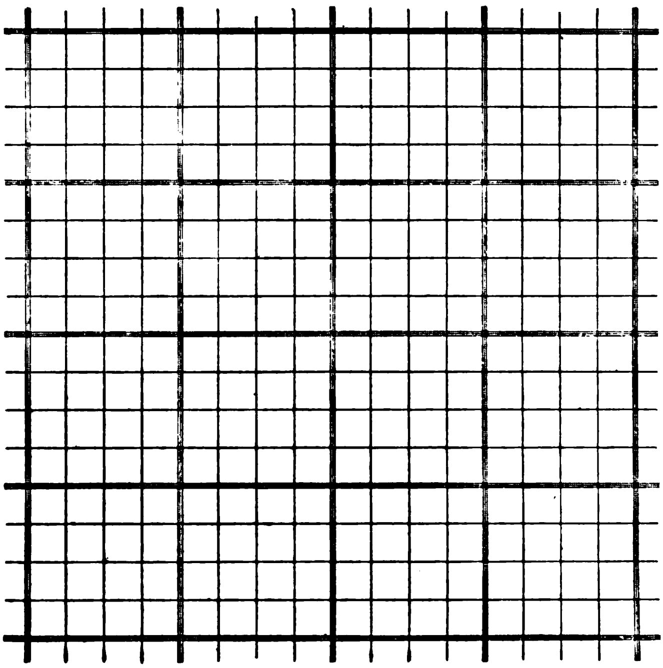


Fig. 85.

to facilitate the counting of both red and white corpuscles; the latter being considerably fewer than the former in a given volume of blood, the areas to be counted should vary in size. The counting chamber advocated by Fuchs and Rosenthal for the cytological investigation of cerebrospinal fluids has a depth of 0·2 mm. The simple plan of cross-lines is shown in the figure (fig. 85). The mixing pipettes consist of an accurately calibrated capillary tube dilated above to form a cavity, and provided with a rubber suction tube. The capillary tube is graduated, the uppermost mark being 1, and the 101 mark being just above the cavity; so that if the fluid to be examined is drawn in up to

the mark 1, and diluting fluid drawn in until the whole stands at 101, a mixture of 1 p.c. is obtained. A glass pebble in the cavity assists the uniform intermixture on shaking.

Numeration of Blood-platelets.*—G. Vallet advocates the following method for the enumeration of blood-platelets. A drop of 1 p.c. osmic acid solution is placed on the back of the thumb just above the nail, and a needle-prick is made across the drop. Some of the mixture of blood and osmic acid is drawn up into a fine pipette, and a very small drop is transferred at once to a clean cover-slip. The specimen is then fixed for half an hour in absolute alcohol, and stained with Giemsa's solution for two hours, washed in water and dried. Fifteen to thirty fields are then examined, and the hæmatoblasts and leucocytes are counted, and their relative proportions noted. The exact number of leucocytes in 1 c.mm. being known from a corpuscular count, it is easy to calculate the number of platelets.

Convenient Laboratory Devices.†—J. S. Fulton describes various laboratory accessories: (*a*) A dust-proof sterilising and storage box for Petri dishes, consisting of a brass base with three upright arms, two of which are fixed and one pivoted and bearing a loose riveted ring; the plates are stacked against the fixed arms, the loose arm is raised and the ring slipped over embracing the two uprights; a cylindrical cover is then slipped down between the uprights and the plates, thus forming a dust-proof package.

(*b*) A cage for holding inoculated plates during incubation. It consists of a brass plate carrying two bent wires that cross in contact at a convenient height, forming four uprights against which the plates may be stacked; a similar wire loose-jointed to the base crosses the other two, and engages a notch at the middle of the bend where all the wires cross; by pressing the two stiff wires together the space on the opposite side opens enough to allow the plates to be stacked; the loose arm is then swung up and sprung into the notch, converting the whole into a safe package.

(*c*) A tray for fermentation tubes. This consists of a brass plate carrying twelve brass pins 1¼ inch high, over which are slipped the hollow stems of the tubes; into the end of each pin is sawn a fine slit, into which is fixed a piece of rubber band, which grips the side of the glass stem and prevents wobbling.

(*d*) An express package for samples of water for bacteriological examination.

(*e*) A portable charcoal oven for making plate cultures at the well side.

(*f*) An extensible box for carrying inoculated plates.

(*g*) A scale for reading gas percentages in fermentation tubes.

(*h*) A new form of water-bath, by which within 10 minutes as many as 70 test-tubes of solid culture material can be melted and cooled ready for inoculation.

* C.R. Soc. Biol. Paris, lxii. (1907) p. 540.
† Centralbl. Bakt., 1te Abt., xliv. (1907) p. 89.

New Fluid for the Hæmocytometer.*—A. Edington has prepared the following solution for use with the hæmocytometer: neutral citrate of sodium 7·5 grm., formalin 2 c.cm., dahlia 0·03 grm., chloroform 5 drops, distilled water 250 c.cm. Mix the stain with the water, and then add the citrate and formalin. Leave for a few days, and use the supernatant fluid; if necessary, filter before use.

WALTON, L. B.—**Contributions to Museum Technique: Cataloguing Museum Specimens.**
[Gives a description of a practical method of registering specimens by means of the card system.] *Amer. Naturalist*, xli. (1907) pp. 77–96 (3 figs.).

LEE, A. B., U. P. MAYER—**Grundzüge der mikroskopischen Technik für Zoologen und Anatomen.** Berlin: R. Friedländer u. Sohn, 3rd edition, 1907, vii. and 522 pp.

Metallography, etc.

Cadmium-bismuth Alloys.†—A. Portevin has determined the equilibrium diagram of this series. The metals were melted together in glass tubes in a current of hydrogen and cooling curves taken, a thermocouple being used. Tammann's method for determining the quantity of eutectic in each alloy was employed. The equilibrium diagram obtained is very simple. No compounds or solid solutions occur; two branches meet at the eutectic point 138° C., 63 p.c. cadmium. The horizontal eutectic line extends completely across the diagram. Microscopic study of the series showed that the alloys consisted of eutectic, together with either acicular crystals of cadmium or cubic crystals of bismuth.

Iron and Arsenic.‡—K. Friedrich has determined the equilibrium diagram and investigated the microstructure of the range of alloys from 91·6 to 44·0 p.c. iron. Five crystalline phases were distinguished. The author has demonstrated the existence of the compounds Fe_2As and Fe_3As_2, and considers that of FeAs as probable. The nature of two phases, one apparently containing more than 90 p.c., the other 48·3 p.c. iron, remains in doubt. With the first of these Fe_2As forms a eutectic at 70 p.c. iron and 830° C. Fe_3As_2 is the product of a chemical reaction occurring in the solid state at 800° C. The freezing point of Fe_2As is 919° C., that of FeAs about 1030° C. No indication of the formation of Fe_3As was obtained. The conclusions drawn from the freezing point curve were confirmed by microscopic examination of the alloys.

Nickel and Arsenic.§—The equilibrium diagram of the series of alloys, containing from 0–57·4 p.c. arsenic has been determined by K. Friedrich. Owing to the complexity of the diagram—15 fields are

* Lancet, 1907, ii. p. 86.
† Rev. de Métallurgie, iv. (1907) pp. 389–94 (6 figs.).
‡ Metallurgie, iv. (1907) pp. 129–37 (19 figs.).
§ Tom. cit., pp. 200–16 (37 figs.).

shown in the region investigated—the results are not adapted for abstraction; the original should be consulted. The compounds are Ni_5As_2 (existing in two modifications), Ni_3As_2 and NiAs. Good agreement was found between the diagram and the results of microscopical examination.

Latent Heat of Recalescence in Iron and Steel.*—F. K. Bailey has determined the mean specific heats of a number of steels of different carbon content between temperatures varying from 470° C. to 860° C. and 20° C., by a calorimetric method. A sphere was heated in an electric resistance furnace with vertical tube, and when at the required temperature dropped into water contained in a calorimeter below. Heating and cooling curves were also taken. From the results obtained were calculated the values of the latent heat of recalescence.

Binary and Ternary Alloys of Tin, Lead, Bismuth and Cadmium.†—The original plan of this research by A. Stoffel was the investigation of the solidification of a quaternary system, these four metals being chosen as giving the simplest case possible. It was found that the systems containing tin and cadmium showed a transformation in the solid state. This introduced so much complication that the study of the quaternary system was abandoned. The author here gives an account of previous work on the six binary systems together with his own results on these and two of the ternary systems. The tin-cadmium series was examined microscopically, but though good preparations were obtained no conclusions as to constitution could be drawn. The theory of equilibrium of ternary systems is worked out fully. The composition of any ternary alloy may be represented by a point within an equilateral triangle, the lengths of the perpendiculars from this point to the three sides representing the percentage of each metal. Thus the three angular points of the triangle represent the three pure metals. If a perpendicular to the plane of the triangle is erected from each point within it, its length proportionate to the freezing temperature of the alloy whose composition is indicated by the point, the surface obtained by joining the upper ends of these ordinates is the solidification surface. A straight line joining one vertex of the triangle to a point on the side opposite is the projection of a series of alloys containing two of the metals in constant proportion to each other with varying proportions of the third. The temperature concentration diagram of this series may be figured in the way adopted for a binary system, ordinates representing temperature, abscissæ the percentage of the varying metal. The liquidus curve is then a section of the solidification surface of the ternary system. By taking cooling curves of a large number of ternary alloys, classified in series forming such sections, the author determined the form of the complete solidification surfaces of the Sn, Cd, Bi, and the Sn, Cd, Pb systems. In the latter the eutectic point is at 145° C. and the composition 57 tin, 21 lead, 22 cadmium atomic p.c. The freezing-point of the eutectic of the other system is 103° C., the composition is 33·2

* Physical Review, xxiv. (1907) pp. 129–51 (8 figs.).
† Zeitschr. Anorg. Chem., liii. (1907) pp. 137–83 (29 figs.).

tin, 39·3 bismuth, 27·5 cadmium atomic p.c. The compound Sn_4Cd is formed in both systems: its normal temperature of formation is 125° C.

Lead-thallium and Lead-indium Alloys.*—N. S. Kurnakow and N. A. Puschin have determined the equilibrium curves of these two systems. The freezing-point curve of the lead-thallium alloys rises from the melting points of both metals to a maximum at 380° C. (33–40 atomic p.c. lead), and shows a sudden change of direction at 310·4° C. (5·5 atomic p.c. lead). The equilibrium curve of the lead-indium system is simple, and indicates a continuous series of solid solutions. The micro-structure of the alloys was investigated.

K. Lewkonja† has also determined the equilibrium diagram of the lead-thallium system; there are important differences between his results and those obtained by the above authors. The maximum at 374° C. is held to indicate the compound $PbTl_2$.

Effect of Stretching on Conductivity.‡—J. A. Donaldson and R. Wilson have determined the specific resistance and density of lead wires, permanently stretched to different extents. The change in conductivity produced was found to be small, and appears to be within the limits of experimental error.

Thermal and Electrical Effects in Soft Iron.§—E. H. Hall, L. L. Campbell, S. B. Serviss, and E. P. Churchill, in carrying out their intention of determining the various properties of the same specimen of soft iron, have obtained the following additional results.‖ Temperature coefficient of thermal conductivity between 115° and 204° C. referred to the value at 115° = −0·00068 approximately. Electric resistance, absolute, 17260 at 100° C. and 26140 at 218·2° C., with a mean temperature coefficient 0·00661 (on the basis of the value at 0° C.) between 100° C. and 218° C. Values for the Thompson effect coefficient are given.

Specific Heat of Iron at High Temperatures.¶—J. A. Harker determined the total heat evolved by iron of a high degree of purity, in cooling from temperatures ranging from 216° C. to 1144° C. to ordinary temperatures. The specimens, enclosed in porcelain protecting tubes, were heated in an electric resistance furnace to the required temperature, then dropped into a thin-walled vessel containing light magnesia, surrounded by the water of the calorimeter. The results indicate that the specific heat rises up to about 900° C., then falls considerably.

Tin-nickel Alloys.**—L. Guillet criticises severely the purely chemical methods employed by Vigouroux for examining alloys, and contends that the determination of equilibrium diagrams and investigation of microstructure must form the basis of all study of alloys. The

* Zeitschr. Anorg. Chem., lii. (1907) pp. 430–51 (9 figs.).
† Tom. cit., pp. 452–6 (1 fig.).
‡ Proc. Roy. Soc. Edinburgh, xxvii. (1907) pp. 16–20.
§ Proc. Amer. Acad. Arts and Sci., xlii. (1907) pp. 597–626 (2 figs.).
‖ See this Journal, 1905, p. 667.
¶ Coll. Researches Nat. Phys. Lab., ii. (1907) pp. 207–14 (2 figs.).
** Rev. de Métallurgie, iv. (1907) pp. 535–51 (17 figs.).

author's diagram showing 22 fields is deduced from the cooling curves and microstructure of 21 alloys. The eight constituents are pure tin, the compound NiSn, and three solid solutions, one of which exists in two, another in three modifications. It is held that a maximum in the liquidus curve does not necessarily correspond with a definite compound.

Recording Pyrometer.* — S. Wologdine describes a method of recording time-temperature curves on a fixed photographic plate. The temperature is indicated by the horizontal deflection of a galvanometer mirror, while a vertical movement is given to the ray of light by a mirror, which is rotated about a horizontal axis. This rotation is secured by means of an arm in connection with a float in a vessel containing water, the level of which falls at a uniform speed. The spot of light thus passes over equal vertical spaces on the photographic plate in equal intervals of time.

Alloys of Cobalt and Tin.†—F. Ducelliez claims to have extracted by chemical methods the compound CoSn from several ingots prepared by melting cobalt and tin together.

Constitution of Alloys of Copper.‡—L. Guillet states some general conclusions regarding the binary alloys of copper. A zone of extreme brittleness occurring in each series, corresponds to a single constituent always behaving in the same manner with reagents.

Boron Steels.§—L. Guillet has examined four steels containing boron 0·2–1·5, carbon 0·18–0·28 p.c., and two with boron 0·15 and 0·41 p.c., carbon 0·47 and 0·59 p.c. Maximum stress is raised by boron both in the normal and quenched conditions. The steels are brittle. The normal steels are constituted of a solid solution iron-boron of low boron content, pearlite, and a special constituent occurring as rounded grains, somewhat resembling cementite in its metallographic reactions. It appears to be a boro-carbide of iron of low carbon content.

Electrical Conductivity of Alloys.‖—W. Guertler deduces from the results obtained by previous workers the relationship between constitution and temperature coefficient of electrical conductivity. While in nearly all pure metals and in alloys free from mixed crystals the temperature coefficient has about the same value, the presence of mixed crystals in alloys lowers this value. The relation between conductivity and its temperature coefficient given by Matthiessen is supported by later results.

Alloys of Iron with Tin and Gold.¶—E. Isaac and G. Tammann give the equilibrium diagrams of these two systems. Iron and tin are not miscible in all proportions in the liquid state. The range in which two layers are formed extends at 1140° C. from 50–89 p.c. tin, and is

* Rev. de Métallurgie, iv. (1907) pp. 552–6 (5 figs.).
† Comptes Rendus, cxliv. (1907) pp. 1432–4.
‡ Tom. cit., pp. 845–8.
§ Tom. cit., pp. 1049–50.
‖ Zeitschr. Anorg. Chem., liv. (1907) pp. 58–88 (13 figs.).
¶ Op. cit., liii. (1907) pp. 281–97 (14 figs.).

probably smaller at higher temperatures. Crystallised γ-iron may contain up to 19 p.c. tin; the solubility of tin in α-iron is not appreciably different. The temperature of magnetic transformation of iron does not appear to be affected by additions of tin or gold. Tin and iron form at least one compound (at 893° C.); its exact composition is not established. Iron and gold give a homogeneous melt in all proportions. They form no compounds. The solubility of gold in iron and of iron in gold in the solid state falls considerably with falling temperature.

Iron-carbon Alloys.*—P. Goerens develops the theory that graphite never separates from the melt as such, but is invariably the product of the decomposition of cementite in the solid state. While the stable system is iron + carbon, iron + cementite being metastable, the accepted diagram represents the equilibrium between iron and cementite. In the molten alloys the carbon exists as carbide. The eutectic at 4·2 p.c. carbon solidifying at 1130° C, is a mixed crystals + cementite eutectic. The formation of kish in high carbon cast iron is explained as follows: On cooling, cementite first separates out from the melt; this splits up into graphite and iron; the iron redissolves in the molten solution of cementite in iron, and the flakes of graphite float to the surface. Among the author's experimental work are determinations of melting points of alloys, and investigation of the microstructure after varying heat treatment. Of two alloys of the same carbon content, existing in one as cementite, in the other chiefly as graphite, the graphitic alloy has the higher melting point; the white cast iron begins to melt at the same temperature at which its solidification ceases. A useful table is given showing the action of various etching reagents on the different constituents.†

Copper and Phosphorus.‡—E. Heyn and O. Bauer have made a complete investigation of the freezing-point curve and the microstructure of the copper-phosphorus alloys. The curve indicates the existence of the compound Cu_3P, confirmed by determinations of density and of E.M.F. against copper in a copper sulphate solution. A eutectic (8·27 p.c. phosphorus, 707° C.) is formed by Cu_3P and a solid solution of very low concentration of Cu_3P in copper. The hardening effect of phosphorus on copper is greater than that of tin; Cu_3P is very hard. Alloys containing more than 15 p.c. phosphorus cannot be prepared by melting, but by heating copper filings and phosphorus to 300°–400° C., richer alloys result. On raising these richer alloys to higher temperatures they lose phosphorus, a definite concentration corresponding to each temperature. At 1100° C. it is 14·1 p.c., i.e. the compound Cu_3P. The alloys over 14·1 p.c. appear to consist of mixed crystals of Cu_3P and Cu_5P_2. Copper ammonium chloride solution was used for etching the microscopic sections.

Copper, Silver, and Lead.§—K. Friedrich and A. Leroux have revised and completed the equilibrium diagrams of the binary systems copper-silver and lead-copper, and have determined the diagram of the ternary system. Two crystalline phases are found in the copper-silver

* Metallurgie, iv. (1907) pp. 137–49, and 173–85 (44 figs.).
† See also this Journal, 1907, p. 116.
‡ Metallurgie, iv. (1907) pp. 242–7 and 257–66 (30 figs.).
§ Metallurgie, iv. (1907) pp. 293–315 (83 figs.).

system, pure (or nearly pure) copper and a solid solution of copper in silver with a maximum concentration of 6 p.c. Osmond had stated that silver could not hold more than 1 p.c. of copper in solid solution. Lead and copper do not mix in all proportions in the liquid state. No compounds occur: the solid phases are the nearly pure metals. Satisfactory agreement with Heycock and Neville's results was found. The ternary system was investigated by taking cooling curves of a large number of alloys. The results are shown as equilibrium curves of 31 series, each series containing a constant percentage of one of the metals. The complete system is represented by the usual method of triangular co-ordinates; the solidification surface is constituted of three portions, any two of which cut each other along a line, while the three meet at the ternary eutectic point (0·5 p.c. copper, 2 p.c. silver, 97·5 p.c. lead) at a temperature 0·5–1° C. below the eutectic freezing temperature of the silver-lead system. Microscopic examination confirms the conclusions based on the equilibrium diagram.

Variation in Melting Point of Eutectic Mixtures.*—C. Benedicks and R. Arpi point out that though a eutectic, like a pure chemical body, has a definite freezing and melting point, yet it is easy to raise the temperature of a eutectic above its true melting point, while this cannot be done with a pure substance without melting taking place. The influence of size of grain was investigated by mixing together powdered lead and tin in eutectic proportion (30 : 70) and taking heating curves. The size of grain varied in different experiments. The authors found that the larger the grain, the higher was the melting point. The bearing of their results on the difference between the melting points of white and grey iron of the same carbon content is indicated.

Chemical and Metallographical Studies of Chilled Cast Iron.†—H. Wedding and F. Cremer give the results of an extended research carried out by the latter. A line is introduced into the iron-carbon diagram indicating that in white cast iron the carbon content of the carbon-saturated first separating mixed crystals is greater than in grey cast iron with the same total carbon. The composition of the mixed crystals is a function of the speed of cooling through the solidification range. In grey cast iron, resulting through slower cooling, the fineness of the graphite flakes appears to be affected by the speed of cooling. The form of the crystals of white iron is characteristic of crystals obtained by the solidification of a super-cooled melt.

ADAMS, J. M.—**Transmission of Röntgen Rays through Metallic Sheets.** *Proc. Amer. Acad. Arts and Sci.*, xlii. (1907) pp. 671–97 (4 figs.).

B'RAUNE, H.—**Micrographic Research on Iron and Steel.** *Zentralbl. f. Eisen.*, ii. (1907) p. 39.

„ **Nitrogen in Iron and Steel.** *Tom. cit.*, pp. 41–3.

„ **Nitrogen Absorption in the Cementation of Iron.** *Tom. cit.*, p. 248.

* Metallurgie, iv. (1907) pp. 416–19 (2 figs.).
† Stahl und Eisen, xxvii. (1907) pp. 833–8 and 866–70 (25 figs.).

BURGESS, G. K.—**Measurement of High Temperatures.**
Electrochem. and Met. Ind., v. (1907) pp. 220–1.

CAMPBELL, A.—**Magnetic Testing of Cast Iron.**
Coll. Researches Nat. Phys. Lab., ii. (1907) pp. 243–54 (7 figs.).

CARPENTER, H. C. H.—**Structure and Critical Ranges of High-speed Tool-steel.**
[For abstract, see this Journal, 1905, p. 776.]
Tom. cit., pp. 53–88 (24 pls.)

CARPENTER, H. C. H., R. A. HADFIELD, & P. LONGMUIR—**Iron-nickel-manganese-carbon Alloys.**
[For abstract, see this Journal, 1906, p. 636.]
Tom. cit., pp. 131–204 (71 figs.).

CHARPY, G.—**Influence of Heat on the Brittleness of Metals.**
Zentralbl. f. Eisen., ii. (1907) p. 50.

CHIKASHIGÉ, M.—**Copper and Tellurium.**
Zeitschr. Anorg. Chem., liv. (1907) pp. 50–7 (7 figs.).

GUERTLER, W.—**Modern Metallography.**
Chem. Zeit., xxxi. (1907) pp. 495–6 (4 figs.).

HARKER, J. A.—**New Type of Electric Furnace, with a re-determination of the Melting-point of Platinum.** *Coll. Researches Nat. Phys. Lab.*, ii. (1907) pp. 37–52 (1 fig.).

HINRICHSEN, F. W., & O. BAUER—**Microchemical Tests for Sulphur, Selenium, and Tellurium, in Copper.** *Metallurgie*, iv. (1907) pp. 315–17.

JÜPTNER, H. v.—**Microstructure of Steel.**
Zentralbl. f. Eisen., ii. (1907) p. 334.

KIP, H. Z.—**A New Method for the Determination of the Hardness of Minerals.**
Amer. Journ. Sci., xxiv. (1907) pp. 23–32.

KURNAKOW, N. S., & S. F. ZEMCZUZNY—**Alloys of Copper with Nickel and Gold.** *Zeitschr. Anorg. Chem.*, liv. (1907) pp. 149–69 (10 figs.).

LUDWIK, P.—**Hardness Measurements by the Brinell Method and Related Impression Methods.** *Zentralbl. f. Eisen.*, ii. (1907) pp. 339–40.

MALMSTRÖM, R.—**Influence of Ball Diameter and Pressure in the Brinell Hardness Test.** *Tom. cit.*, pp. 120–1.

PREUSS, E.—**Results of Recent Fatigue Research on Metals.**
Tom. cit., pp. 199–200

RINNE, F., & H. E. BOEKE—**Transformations of Sulphide of Iron.**
Zeitschr. Anorg. Chem., liii. (1907) pp. 338–43 (1 fig.).

RUDOLFI, E.—**Silicides of Copper.** *Tom. cit.*, pp. 216–27 (14 figs.).

TAMMANN, G.—**Isomorphism of the Elements.** *Tom. cit.*, pp. 446–56 (1 fig.).

The Corrugation of Rails. *Engineering*, lxxxiii. (1907) pp. 763–5 (12 figs.),

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 19th of June, 1907, at 20 Hanover Square, W. The Right Hon. Lord Avebury, F.R.S., Etc., President, in the Chair.

The Minutes of the Meeting of the 15th of May, 1907, were read and confirmed, and were signed by the President.

The following Donation to the Society was announced, and the thanks of the Meeting were voted to the donor.

	From
Slide of Hair from Flank of Cow, showing wool like structure ..	*Mr. J. E. Lord*

Dr. Hebb called attention to a slide of cow's hair, having all the characters of wool, which had been sent to the Society by Mr. J. E. Lord —whose letter concerning it was read to the Meeting, as follows:

"I am sending herewith, for the Society's cabinet, a slide I have mounted of cow's hair, from the flank, showing wool-structure. I should like it to be shown to the Fellows with as much of the following explanation as you think suitable. Felt, which, owing to prohibitive tariff, had to be free from wool, was sent to a German merchant. On arrival at the German port, it was refused admittance except on the higher scale on the ground that it contained wool. On examination I also reported that it was made up of cow's hair and jute, with 4 per cent. and 5 per cent. each of flax and *wool*. I was assured *no wool* had been used. The head of the firm (a personal friend) had another lot made, the materials of which had been mixed under his own personal supervision, and he gave me his word of honour that not a particle of wool had been used. Still I found wool. I then asked for, and received separate samples of the four materials used in manufacture, and in cow's hair found what I unhesitatingly pronounced to be wool. I was assured none had been mixed with it at the works, and as wool was from four to six times dearer than the hair, there could be no question of adulteration by the merchant of the cow's hair. I then went to the cow, and from various parts, but especially from the flank, I found many hairs, with a true wool-like structure. Of course, this is not confined to the sheep, as many goats, the llama and even the camel, have hair which commercially is known as wool, but, so far as I am aware, the above fact is new for the cow. Faithfully yours, J. E. Lord."

Dr. Hebb said he was exhibiting in the room that evening an interesting slide of fluid crystals. It had been known for some

years that an intermediate physical state existed between the solid and liquid forms of matter—i.e. substances presented themselves as liquids whilst still retaining certain characteristics of their solid state. But comparatively recently this intermediate state had been found to occur in animal tissues, and it was to Adami of Montreal and Aschoff of Marburg (who made a communication to the Royal Society in May 1906) that we owed the demonstration of potential fluid crystals in certain organs—e.g. the Adrenal gland. In the body these substances, probably some combination of oleic acid, only possessed the potentiality, but when cooled down to room temperature these oily globules were found to possess the quality of double refraction by which they were easily recognised when subjected to polarised light. With ordinary light they were quite indistinguishable from fat globules.

Mr. Rousselet said he was exhibiting under a Microscope in the room a group of six Stephanoceri, mounted with all their tentacles expanded.

Mr. E. M. Nelson's paper "On Eye-Pieces for the Microscope" was read by Dr. Hebb.

The thanks of the Society were unanimously voted to Dr. Hebb and to Mr. Nelson for their communications.

Mr. F. Enock then gave a very interesting lecture "On the Life-History of the Tiger Beetle, *Cicindela campestris*," illustrating the subject by a series of excellent lantern slides, exhibiting the insect in all stages, the structure of its burrow, its method of capturing its prey, and its metamorphoses from larva to pupa and imago. The slides were from original drawings by the lecturer, and represented the results of observations extending over a period of twenty years.

The President said that the well-merited applause which had accompanied and followed Mr. Enock's remarks showed how much interest and pleasure they had derived from this lecture. He could not quite determine which of the two, Mr. Enock or the insect, had displayed the more patience or ingenuity; but however that might be, he felt sure they had all been greatly interested to hear what his old friend Mr. Enock had described so graphically and with so much humour, and they were all grateful to him for the treat which he had given them. He had shown great patience and perseverance in unravelling the life-history of this beetle, and as gratitude had been defined to be a sense of favours to come, they hoped it would in this case indicate their desire to hear in the future more and more of Mr. Enock's very interesting lectures.

Pursuant to the notice given at the preceding Meeting, the Meeting was then made Special for considering the desirability of altering By-law 65A so as to read as follows:—

"65A. The Council shall at the Annual Meeting propose a Fellow or Fellows of the Society to act, either separately or jointly, as Curator

or Curators of the Instruments, Tools and such other property belonging to the Society as may from time to time be confided by the Council to his or their care. They shall be elected by the Society. They shall make and keep a catalogue or catalogues of all the property under their charge respectively, and shall make an Annual Report or Reports to the Council as to the state of such property."

The President having formally put it to the Meeting that the proposed alteration be made, the motion was unanimously carried.

It was pointed out that this would of course involve a verbal alteration in By-law No. 89, where "Curators" would be substituted for "Curator."

Notice was given that the Rooms of the Society would be closed from August 16 to September 16.

The Meeting was then adjourned to October 16.

The following Objects, etc., were exhibited:—

The Society:—Slide of British Wool, carded.

Dr. Hebb:—Slide of Hair from flank of Cow, showing wool-like structure, from Mr. J. E. Lord; Two Slides of Sections of Adrenal Gland, showing fluid crystals, (1) with ordinary light, the sphero-crystals being indistinguishable from common fat globules, (2) with polarised light, showing that the crystals possess the power of double refraction, exhibiting a well-marked cross.

Mr. C. F. Rousselet:—Slide of a group of six Stephanoceri, mounted.

Mr. F. Enock:—Lantern Slides shown on the screen in illustration of his lecture "On the Life-History of the Tiger Beetle, *Cicindela campestris*."

New Fellow:—Mr. John H. Pledge was balloted for and duly elected an *Ordinary* Fellow of the Society.

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Journal of the Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(Principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

EDITED BY

R. G. HEBB, M.A. M.D. F.R.C.P.

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

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Regius Professor of Natural History in the University of Aberdeen

A. N. DISNEY, M.A. B.Sc. CECIL PRICE-JONES, M.B. Lond.

FELLOWS OF THE SOCIETY

AND

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Keeper, Department of Botany, British Museum

HAROLD MOORE, B.Sc.
Woolwich Arsenal

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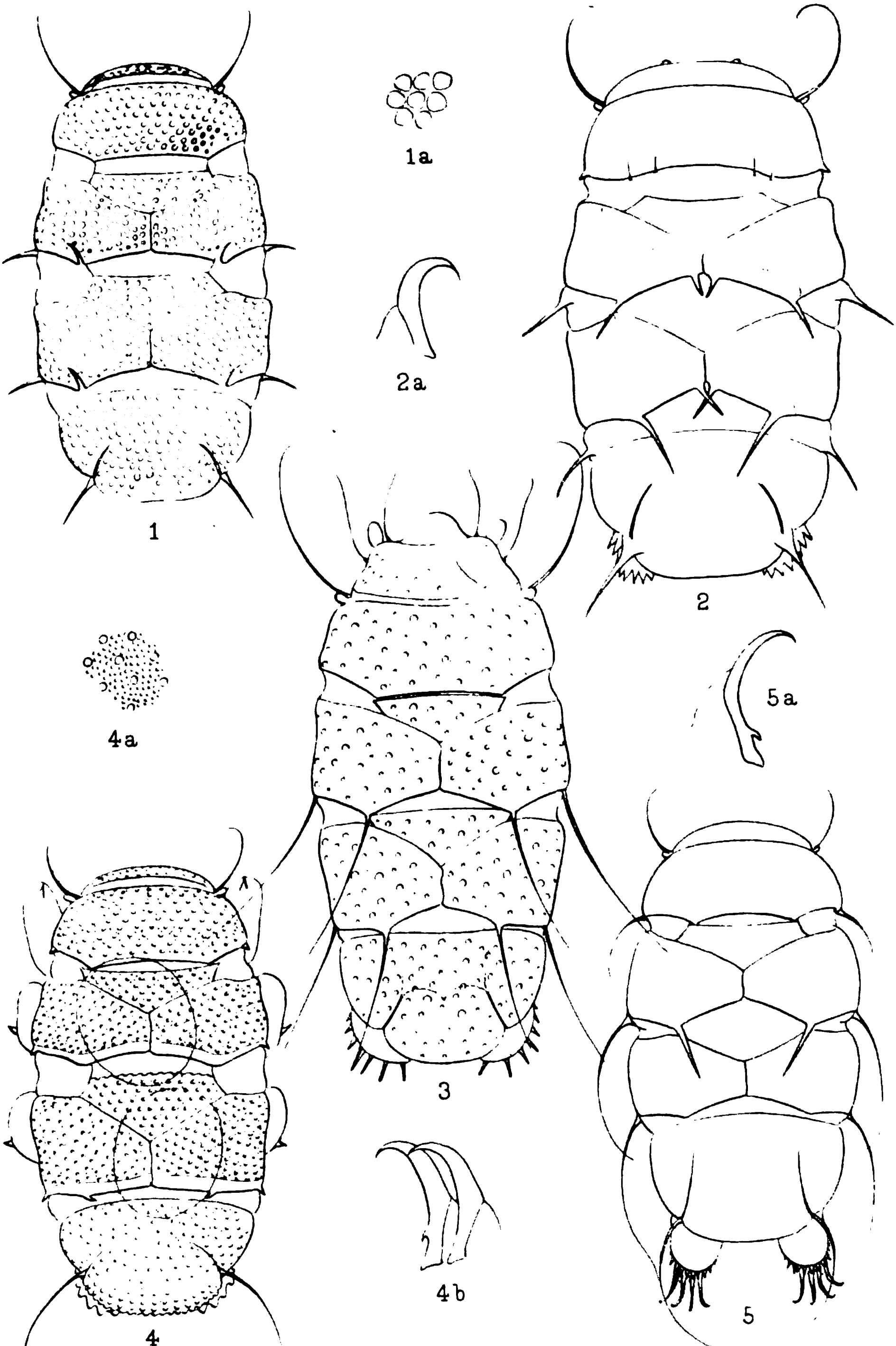

J. Murray del. ad nat

West, Newman photo-lith.

South African Tardigrada.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

OCTOBER, 1907.

TRANSACTIONS OF THE SOCIETY.

XII.—*Some South African Tardigrada.*

BY JAMES MURRAY.

(*Read March* 20, 1907.)

PLATES XVII. AND XVIII.

THE compilation of this short list of African Tardigrada has been rendered possible by the kindness of Mr. W. Milne, of Uitenhage, Cape Colony, formerly of Glasgow. Mr. Milne's work on Rotifera, extending over the past twenty years, and published from time to time in the Proceedings of the Philosophical Society of Glasgow, is well known.

While corresponding with him about the Bdelloid Rotifera, Mr. Milne sent to me from time to time, during the year 1906, moss from various parts of Cape Colony.

In addition to the Bdelloid Rotifers, which were abundant, and of which many peculiar species occurred, this moss yielded a good many Tardigrada.

EXPLANATION OF PLATE XVII.

Fig. 1*a*.—*Echiniscus* sp. (?)
„ 1*b*. „ „ Portion of dorsal surface.
„ 2*a*.—*E. africanus* sp. n.
„ 2*b*. „ „ Claw.
„ 3. —*E. longispinosus* sp. n.
„ 4*a*.—*E. perarmatus* sp. n.
„ 4*b*. „ „ Portion of dorsal surface.
„ 4*c*. „ „ Outer and inner claws.
„ 5*a*.—*E.* sp. (?)
„ 5*b*. „ Inner claw.

Fourteen species have been found, belonging to the three genera, *Echiniscus*, *Milnesium*, and *Macrobiotus*.

There are eight species of *Echiniscus*, and five of *Macrobiotus*; of *Milnesium* there is only one well established species known.

It is remarkable that eight out of the fourteen species are distinct from any species previously known. The only known species of *Echiniscus* found is *E. arctomys*; the known species of *Macrobiotus* are *M. echinogenitus* Richters, and *M. hufelandii* Richters; *M. arcticus* is a doubtful identification; *Milnesium tardigradum* is of world-wide distribution.

Two of the species of *Echiniscus* were not sufficiently studied to justify me in naming them, but they are figured and described.

List of Species.

Echiniscus arctomys Ehr.
" *bispinosus* sp. n.
" *africanus* sp. n.
" *perarmatus* sp. n.
" *longispinosus* sp. n.
" *crassispinosus* sp. n.
" sp. (?)
" sp. (?)
Milnesium tardigradum Doy.
Macrobiotus hufelandii Richters.
" *echinogenitus* Richters.
" *arcticus* Murray (?).
" *nodosus* sp. n.
" *crassidens* sp. n.

Echiniscus.

There are two well-marked groups within the genus. The first has segments v. and vi., as defined by Richters (*8*),* quite distinct. Segment v. is either a half-ring or forms a third pair of plates. Two African species belong to this group, *E. arctomys* and *E. bispinosus*, and both have segment v. as a half-ring.

The second group has segments v. and vi. completely united, so that the junction cannot be distinguished. The common plate thus formed is rendered trilobate by two lateral clefts, in the same way as plate vi. of the first group. This group includes six of the African species, and the great majority of known species.

In the descriptions of species of *Echiniscus* the body is regarded, following Professor Richters (*8*), as consisting of six segments, which are distinguished by Roman numerals i.–vi. These numbers correspond with names I have used for the various plates, as

* The figures in brackets refer to the list of literature at end of paper.

follows: i. = the head; ii. = the shoulder; iii. = the first pair; iv. = the second pair; v. and vi. together = the lumbar plate. The five commonest lateral processes are distinguished by the letters *a, b, c, d, e,* consecutively from the head backwards. Any one of these, except *a*, may be absent, but the process in the corresponding position is always referred to by the same letter: *a* comes after segment i., *b* after segment ii., *c* after segment iii., *d* after segment iv., and *e* at the slit which separates the lateral and posterior lobes of vi.

The two commonest dorsal processes are over the lateral processes *c* and *d*, on the angles of the paired plates of segments iii. and iv. The median plates are intercalated between the segments —the first median between ii. and iii., the second between iii. and iv., the third (when there is a third) between iv. and v.

A. Segments V. and VI. Distinct.

E. arctomys Ehr. (?) plate XVIII. fig. 11.

This widely-distributed species was the most abundant in all the African collections.

The second median plate is separated from the pair of plates in front of it by a very obscure line, and the third median plate is separated by a similar line from the half-ring which follows it.

Examples with two and three small roundish eggs were found.

The largest African examples were unusually large for the species, measuring 260 μ in length, exclusive of the last legs, and were somewhat stout.

The pellucid dots on the plates are granules, and there are similar dots on the skin connecting the plates, and on the legs.

E. bispinosus sp. n., plate XVIII. fig. 7.

Specific Characters.—Small, red. Plates, 11: 3 median, 2 pairs, v. and vi. separate, vi. 3-lobed, all finely punctate. Lateral processes, on each side a spine with bulbous base after segment iii. (*c*, Richters). Head setæ or horns (*a*, Richters) short. No dorsal processes, fringe on 4th leg, or barbs on the claws.

Length 130 μ. Very like *E. arctomys*, and distinguished chiefly by the lateral spines. The second median plate seems more sharply separated from the pair in front. The median plates could not be seen to be transversely divided, as is the case with most species of this section of the genus, but those plates change greatly in appearance with the point of view and attitude of the animal. The pellucid dots, as in *E. arctomys*, extend on to the membrane connecting the plates.

Rare, and no eggs seen.

B. Segments V. and VI. Completely United.

E. africanus sp. n., plate XVII. figs. 2*a*, 2*b*.

Specific Characters.—Small. Plates, 10: arrangement normal—2 pairs, 3 median, vi. trilobate. Lateral processes, *a* a seta, *b* a spicule, *c*, *d*, and *e* short spines with expanded bases. Dorsal processes, 4 acicular points on the interspace behind ii., 2 short spines on the posterior border of each plate of the first pair—one on the angle, and one near the median line—2 similar spines on the plates of the second pair. Plates regularly dotted. Fringe of sharp teeth on 4th leg.

Length 150 μ. The paired plates are each sub-divided by obscure curved transverse lines into three parts. This division may be of the same kind as that which gives rise to many small plates in Professor Richter's two species, *E. quadrispinosus* and *E. scrofa* (*8*).

The first and second median plates are each crossed by a transverse line, which appears to separate two distinct parts. The part posterior to the line is certainly punctate, but it is doubtful if the anterior part is punctate, and I am uncertain whether it forms a plate of equal value with the other, as it does in several species (*E. islandicus*, etc.), or if it is merely a connecting membrane.

Professor Richters calls attention to the correspondence of the 4 acicular points with the spicules occupying the same position in *E. islandicus*.

There is, indeed, a considerable superficial resemblance between this species and *E. islandicus* (*12*) and *E. borealis* (*6*), especially the latter. Those are the only two species previously described which have processes on the paired plates between the angle and the median line of the body. The lateral processes correspond, except in relative size; the processes near the middle line agree with those of *E. borealis*; and the transverse division of the median

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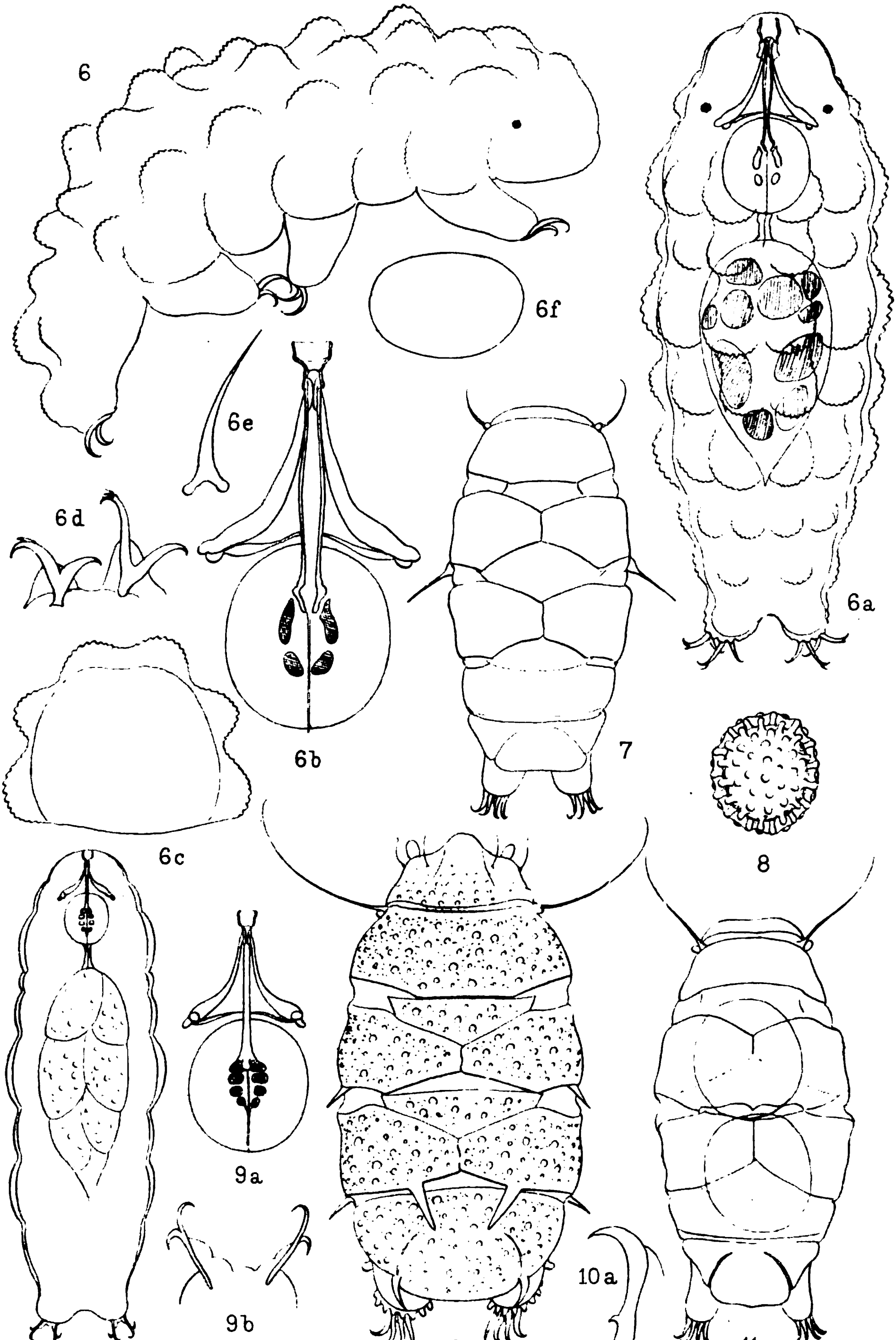
EXPLANATION OF PLATE XVIII.

Fig. 6*a*.—*Macrobiotus nodosus* sp. n.		Side view.
„ 6*b*.	„ „	Dorsal view.
„ 6*c*.	„ „	Teeth and pharynx.
„ 6*d*.	„ „	Optical section.
„ 6*e*.	„ „	Claws.
„ 6*f*.	„ „	Side view of tooth.
„ 6*g*.	„ „	Egg.
„ 7. —*Echiniscus bispinosus* sp. n.		
„ 8. —*M. arcticus* Murray (?)		
„ 9*a*.—*M. crassidens* sp. n.		
„ 9*b*.	„ „	Teeth and pharynx.
„ 9*c*.	„ „	Claws.
„ 10*a*.—*E. crassipinosus* sp. n.		
„ 10*b*.	„ „	Inner claw.
„ 11. —*E. arctomys* Ehr.		



J. Murray del. ad nat.

West, Newman photo-lith.

South African Tardigrada.

plates increases the resemblance. Notwithstanding all those points of agreement, *E. africanus* is not even in the same section of the genus, for segments v. and vi. are completely fused, without a trace of the line of junction.

The dots on the plates look like pits. The little spines on the paired plates are so near the median line that they usually overlap, and look like pairs of scissors.

The head setæ or horns (*a*, Richters) are of moderate length, and curved forward and inward in the normal fashion.

Whether there are barbs on the inner claws I have been unable to see, owing to the position of the legs in the few examples studied.

Three examples seen, and none with eggs.

E. perarmatus sp. n., plate XVII. figs. 4*a* to 4*c*.

Specific Characters.—Size, moderate. Plates, 9: 2 median, 2 pairs, vi. trilobate. Pattern of two kinds, coarse dots, regularly arranged, and very fine pellucid dots. Lateral processes, *a* a short curved seta, *b*, *c*, and *d* spicules, *e* a long curved spine or seta. Dorsal processes, on each side a spicule on each plate of the second pair, above *d*. Spicules on 1st, 2nd, and 3rd legs. Fringe of longish obtuse processes on the 4th leg. Inner claws with small barbs.

Length, 260 μ. Eggs oval, red, 66 μ long. Larva, with two claws, length 96 μ. The larva has all the processes of the adult, but the lateral seta *e* is shorter. The paired plates have, along the posterior border, a broad plain marginal band, without dots.

Among the external characters of Tardigrada there is nothing so puzzling as the nature of the dots on the plates, usually referred to as granulation. Plate (*7*, p. 294) regards those dots as "dimples," and in my experience they also most commonly appear as depressions, but there is no doubt that the nature of the surface-texture varies in different species. Plate (*7*, p. 294) supposes that Doyère regarded the dots as really papillæ, since he named a species *E. granulatus*, but I would suppose that his naming one species thus might be to emphasise a contrast between it and the others. Certainly a species closely agreeing with *E. granulatus* Doy. (*1*) is the only one in which I have seen granules, unmistakable and large. Some others, as *E. arctomys*, I believe to be granular, but the condition is less obvious.

In no species are the dots so puzzling as in *E. perarmatus*. The larger dots, which are arranged in regular rows, appear over the general surface of all the plates as pits, but the rows can be traced without interruption from the centre of the lumbar plate (v. and vi.) to the posterior border of the middle lobe (tail-piece), and there they are certainly papillæ. On the second median plate,

on the other hand, the anterior margin appears as though the plate were there bent over, showing the dots in profile, as "dimples."

Dots of two kinds are also found in a Scottish species which I identify as *E. oihonnæ*. In that case the dots are all of equal size, and the darker ones look as though one here and there of the pellucid dots had been punched out, leaving a hole. Though Professor Richters makes no reference to the texture in "Nordische Tardigraden" (*9*), nor in "Arktische Tardigraden" (*10*), his figure in the latter work (plate xv. fig. 4) gives colour to the belief that his animal had also two kinds of dots.

Skins with two and three eggs were seen.

Cape Colony. One of the most abundant species. The name is given in reference to the protection of the legs, as well as the back, by spines. I know no other species with such spines on the 2nd and 3rd legs, though the spine on the 1st leg is common to nearly all Echinisci.

E. longispinosus sp. n., plate XVII. fig. 3.

Specific Characters.—Size, moderate. Plates, 9: 2 median, 2 pairs, v. and vi. united, 3-lobed, 5 faceted. Lateral processes, *a*, *c*, and *d*, long fine seta. Dorsal processes, a long fine seta on the angle of each plate of the first and second pairs (segments iii. and iv.). Four setæ round mouth, long, and palps large. Coarsely punctate, dots distant. Fringe of long peg-like processes, standing apart, on the fourth leg.

Length, 200 μ. Eyes red. Fringe hyaline. No barbs could be detected on the inner claws. In such cases minute barbs may be present, as in *E. mutabilis* (*3*) but they may be readily overlooked. The eight posterior setæ (on the paired plates) are equal and very slender.

The dots are of unequal size and very widely spaced. They look like depressions. The eggs were not seen.

The name refers not only to the principal setæ, which are, however, not so long as in some other species (*E. merokensis*, *E. oihonnæ*, etc.), but to the elongation of all the lesser processes. The mouth-bristles and the teeth of the fringe are relatively longer than in any other species known to me.

Cape Colony. One example seen. Though no eggs were found to indicate maturity, the species is sufficiently distinct from all other known species.

The faceting of the plate formed by the union of segments v. and vi. is shared by several species. *E. reticulatus* Murray (*3*) has only 4 facets, *E. meridionalis* Murray (*4*), and another (unnamed) species from the South Orkneys have 5 facets just like *E. longispinosus*.

E. crassispinosus sp. n., plate XVIII. figs. 10*a*, 10*b*.

Specific Characters.—Size, moderate. Plates, 9: 2 median, 2 pairs, v. and vi. united, 3-lobed. Dots of two kinds: large, distant, and small, pellucid. Lateral processes, *a* long seta; *c*, *d*, and *e*, short spines. Dorsal processes, a broad flat spine on each plate of the second pair, nearer the median line than the angle. Fringe of blunt processes on the 4th leg. Blunt palp at base of 4th leg. Small barbs on the inner claws of all legs.

Length, 260 μ, exclusive of last legs. The four mouth-bristles are small. The head setæ or horns (*a*) are very long, and widely spreading, like the horns of Highland cattle. The double pattern on the plates is like that of *E. perarmatus*—the larger dots look like depressions, and the smaller like fine pellucid granules. The larger dots are not in this species arranged in regular rows, but scattered, more widely separated, and of unequal sizes. The colour is red.

The palp on the 4th leg is common to most species. The claws are somewhat broad, and the minute decurved barbs are near their bases.

Cape Colony. Several examples. Though no eggs were seen, the animal has too many peculiarities to be united with any known species.

Echiniscus sp., plate XVII. figs. 1*a*, 1*b*.

Description.—Small. Plates, 9: 2 median, transversely subdivided. Lateral processes, *a* seta, *c*, *d*, *e*, short spines. Dorsal processes, short curved spines on each plate of the pairs. Dots very large and close. Fringe and barbs not seen. Colour, yellow. Claws, four.

Length 120–150 μ. Dots appear to be depressions, obscurely polygonal, by reason of contiguity.

Professor Richters suggests that this may be the young of *E. quadrispinosus* Richters, with which the processes agree. The pattern is, however, quite different, more regular, and closer, and is not interrupted by bands as in that species.

Very probably a distinct species, but as yet insufficiently studied.

Cape Colony. Two examples.

Echiniscus sp., plate XVII. figs. 5*a*, 5*b*.

Small, pale red, finely dotted. Plates, 9 or 10 (3rd median doubtful), arrangement normal. Lateral processes, *a*, *b*, *c*, *d*, *e*, all incurved setæ. Dorsal process, a spine of moderate length over *c*. Fringe of small acute teeth. Inner claws with small barbs. Length 190 μ. Only one skin seen, without eggs.

The pattern of the plates is close and regular, and the dots appear to be depressions. The five lateral processes agree with *E. victor* Ehr. (*2*), but the proportional sizes of the processes are different, and there is only one dorsal process on each side instead of two. Professor Richters (*11*) describes, without naming or figuring, an almost exactly similar species.

Milnesium.

M. tardigradum Doy. (*1*).

In Scotland the shorter claws of this species are variable, having from one to three points on each. All the African examples seen had three points on the shorter claws of all legs.

One skin contained three eggs.

Cape Colony. Only a few examples.

Macrobiotus.

The genus is divided into sections according to the characters of the eggs, which are either spiny, in which case they are laid free, or smooth, and are then laid several together in the skin when it is cast. A few of the spiny eggs have the rods imbedded in a clear matrix. Examples of all three kinds are among the African species.

The pharynx contains several rows of hard bodies (3 double rows) referred to as *rods* or *nuts*. The number of these free rods is always either two or three, exclusive of a short process at the anterior end of each row, which appears to be joined to the gullet, and another small nut at the posterior end of each row, which Professor Richter calls a "comma." The anterior nut is rarely or never absent, but many species have no "comma."

A. Eggs Spiny, Laid Free.

M. hufelandii (Richters) (*9*) (*10*).

Diverse animals have been identified by various authors as Schultze's *M. hufelandii* (*13*). The species found in South Africa is that referred to under this name in Professor Richter's various works, and which I have followed him in recording from different parts of the world under the same name. It has the claws of each pair united about half-way up, the pharynx with a nut, a long double rod, a shorter rod, and a "comma" in each row of thickenings. The egg has processes which are conical in the lower portion, and expanded above into a disk. It is a well-marked species, accurately characterised by Professor Richters, though its identity with Schultze's species may be questioned, the description of that species being, like most of the early descriptions, rather inadequate.

M. echinogenitus Richters (*9*).

The animal found is Richters' type as found in Spitzbergen, with the pairs of claws divergent like the letter V, three short rods in each row of pharyngeal thickenings, and the spines of the egg without areolation in the interspaces. The well-developed young was squeezed out of the egg. The pharynx has a "comma" in each row of thickenings, besides the three principal rods.

M. arcticus ? Murray (*6*), plate XVIII. fig. 8.

This doubtful identification depends on the finding of an egg of the peculiar type of structure of which *M. hastatus* Murray (*5*) is the best known example. The rods on the egg surface are most like those of *M. arcticus,* but are larger and thicker.

B. Eggs Smooth, Laid in the Cast Skin.

M. nodosus sp. n., plate XVIII. 6*a* to 6*g*.

Specific Characters.—Large, yellow, with large papillose dorsal tubercles in transverse rows, 6 on each segment (see fig. 6*d*) and 6 on each intermediate false segment. Pharynx with two thick rods in each row, the first twice as long as the second, and no "comma." Claws united for a short distance above the base, then divergent, one of each pair longer, and the long claw of one pair longer than that of the other; long claws with supplementary points. Eggs, elliptical, reddish brown, smooth. Dark eyes.

Length up to 500 μ, pharynx 50 μ long. Superficially resembling *M. tuberculatus* Plate (*7*), this species differs in nearly all details of structure. It is much larger, and highly coloured, while *M. tuberculatus* is colourless. The claws of *M. tuberculatus* are widely divergent from the very base, and there are three short equal rods in each row of pharyngeal thickenings.

The pharynx is of the same type as *M. hufelandii* Richters, but the longer rod is not so clearly double, or formed by the joining end to end of two shorter rods. The basal thickening at the end of the gullet looks more like an expansion of the gullet than separate nuts, and there is no comma.

The longest claw of each foot has two supplementary points, but two points were not distinguished on the long claw of the lesser pair.

The stomach is pear-shaped, of few large cells enclosing sienna-brown matter. The coloration of the whole animal is distinctive: yellow skin, salmon-coloured eggs, and brown stomach.

Cape Colony. Very abundant. Many skins were found with eggs, up to 6 in number, the skins retaining the characteristic tubercles.

C. Eggs Unknown.

M. crassidens sp. n., plate XVIII. figs. 9*a* to 9*c*.

Specific Characters.—Small, hyaline. Teeth strongly bent in middle. Pharynx with two free nuts in each row, besides large nut at end of gullet, and large comma; nuts very short and broad, often as broad as, or broader than, long. Claws very slender, each pair united more than half way.

Length 250 μ. No eyes. Stomach walls of few large cells, only about 6 visible in one view. No supplementary points could be seen on the longer claws.

This appears to be the African representative of *M. intermedius* Plate (*7*), as more fully described by Professor Richters (*10*). Compared with examples of that species sent to me by Professor Richters, *M. crassidens* has broader teeth, and more slender claws, united for a greater proportion of their length.

No eggs were found.

The first nut in the pharynx is unusually large, and seems to be more closely united to the gullet than in most species. It gives the end of the gullet the appearance of being expanded into a funnel. Similar expanded cuneate processes at the end of the gullet are found in several species not at all closely related to *M. crassidens*, as *M. coronifer*, *M. granulatus*, and *M. zetlandicus*.

Cape Colony. Fairly abundant.

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XIII.—*Eye-pieces for the Microscope.*

By EDWARD M. NELSON.

(*Read June* 19*th*, 1907.)

As several friends have asked me to provide the numerical values for some of the eye-pieces described in my Presidential Address for the year 1900, I thought it would probably save further trouble if a list were published. In my own work the eye-pieces in Table I. have quite superseded those of the compensating form. There is no reason why these eye-pieces should not be produced at a price only slightly in excess of the ordinary Huyghenian, as they are composed of only two bi-convex lenses. In these eye-pieces in Table I., the refractions are equally divided between the two lenses, the equation for achromatism (given by Coddington, in his "System of Optics," at the foot of p. 261, as well as by other writers) is also satisfied, and the direct pencil is equally refracted by both surfaces of the field-lens.

In the following Tables s is the radius of the surface of the eye-lens next the eye, r that of the other surface, and b is the diameter of the eye-lens.

S, R, and B have a similar significance with regard to the field-lens; d' is the distance of the lenses apart, measured from their surfaces (which is 3½ p.c. less than d in the original formula, where the distance is that between the Gauss points) and h is the diameter of the hole in the diaphragm.

$$b \text{ and } h = cf'; \qquad c = \cdot 575 \text{ for a 6 inch field.}$$

$$B = \frac{cff'}{f - f'(a-1)} = cF$$

$$= \frac{10\,c}{m} \text{ for long tube, and } \frac{6 \cdot 3\,c}{m} \text{ for short tube.}$$

These values of B require to be increased to allow for the edging and mounting of the lens. In the Tables, B for the long tube was made $\frac{6 \cdot 9}{m}$ for powers of 12 and under; $\frac{7 \cdot 19}{m}$ for powers 15 to 25; and $\frac{7 \cdot 475}{m}$ for powers 30 to 40.

The corresponding values for the short tube were

$$\frac{4 \cdot 35}{m}; \quad \frac{4 \cdot 53}{m}; \quad \text{and } \frac{4 \cdot 71}{m}.$$

Table I.—FORMULÆ FOR MICROSCOPE EYE-PIECES.

Long Tube, 10 inches.

Jena Glass O·82; $n = 1·4944$; $\nu = 66·5$.

Power	6		8		10		12		15		20		25		30		35		40	
	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.
s	1·96	49·8	1·51	38·3	1·22	31·0	1·03	26·1	0·829	21·1	0·626	15·9	0·502	12·8	0·419	10·6	0·359	9·1	0·314	8·0
r	0·654	16·6	0·503	12·8	0·408	10·4	0·343	8·7	0·276	7·0	0·209	5·3	0·168	4·26	0·140	3·55	0·120	3·05	0·105	2·66
b and *h*	0·57	14·5	0·44	11·1	0·36	9·0	0·30	7·6	0·24	6·1	0·182	4·62	0·146	3·71	0·122	3·10	0·104	2.64	0·091	2·32
S	3·84	97·5	3·46	87·8	3·15	80·0	2·89	73·4	2·58	65·5	2·19	55·7	1·91	48·5	1·70	43·2	1.54	39·0	1·40	35·6
R	1·85	47·0	1·42	36·0	1·15	29·2	0·967	24·5	0·783	19·9	0·598	15·2	0·486	12·3	0·410	10·4	0·356	9·0	0·316	8·0
B	1·15	29·2	0·86	21·9	0·69	17·5	0·57	14·6	0·48	12·2	0·36	9·1	0·29	7·3	0·25	6·3	0·21	5·4	0·187	4·75
d'	1·93	49·1	1·49	37·9	1·22	30·9	1·03	26·1	0·835	21·2	0·638	16·2	0·518	13·2	0·437	11·1	0·379	9·6	0·335	8·5

Short Tube, 6·3 inches.

	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.
s	1·22	31·0	0·937	23·8	0·759	19·3	0·636	16·2	0·512	13·0	0·385	9·8	0·308	7·8	0·256	6·5	0·218	5·5	0·190	4·82
r	0·408	10·3	0·312	7·9	0·253	6·4	0·212	5·4	0·171	4·34	0·128	3·25	0·103	2·61	0·085	2·16	0·073	1·85	0·063	1·61
b and *h*	0·36	9·0	0·27	6·9	0·22	5·6	0·185	4·70	0·149	3·78	0·112	2·84	0·089	2·27	0·074	1·89	0·063	1·61	0·055	1·40
S	3·65	92·8	2·20	55·9	2·02	51·2	1·86	47·3	1·67	42·5	1·44	36·6	1·28	32·4	1·15	29·2	1·05	26·7	0·973	24·7
R	1·02	26·0	0·917	23·3	0·749	19·0	0·635	16·1	0·520	13·2	0·403	10·2	0·333	8·4	0·286	7·2	0·252	6·4	0·226	5·7
B	0·725	18·4	0·543	13·8	0·435	11·0	0·362	9·2	0·302	7·7	0·226	5·7	0·181	4·60	0·157	3·99	0·135	3·43	0·118	3·00
d'	1·23	31·3	0·955	24·3	0·783	19·9	0·665	16·9	0·544	13·8	0·421	10·7	0·346	8·8	0·295	7·5	0·258	6·6	0·231	5·9

Table II.—FORMULÆ FOR MICROSCOPE EYE-PIECES.

Long and Short Tubes.

Jena Glass O·82; $n = 1·4944$; $\nu = 66·5$.

Power.	3·15 and 5		4 and 6·3		5 and 8		6 and 9·5		8 and 13		10 and 16		12 and 19		15 and 24		20 and 32		25 and 40	
s and S = ∞	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.
b and r	0·578	14·7	0·470	11·9	0·378	9·6	0·306	7·8	0·232	5·9	0·190	4·82	0·159	4·04	0·128	3·25	0·096	2·44	0·077	1·95
h	0·65	16·5	0·55	13·9	0·44	11·1	0·36	9·0	0·27	6·9	0·22	5·6	0·185	4·70	0·149	3·78	0·112	2·84	0·089	2·27
R	1·42	36·2	1·20	30·5	1·01	25·6	0·801	20·3	0·648	16·5	0·546	13·9	0·473	12·0	0·397	10·1	0·315	8·0	0·264	6·7
B	1·25	31·7	1·10	27·8	0·86	21·9	0·73	18·4	0·54	13·8	0·435	11·0	0·362	9·2	0·302	7·7	0·226	5·7	0·181	4·60
d'	2·27	57·7	1·85	47·0	1·49	37·9	1·23	31·3	0·95	24·3	0·78	19·9	0·66	16·9	0·54	13·8	0·421	10·7	0·346	8·8
b and h	0·37	9·5	0·38	9·7	0·39	9·9														
B	0·75	19·0	0·75	19·0	0·75	19·0														
d'	2·33	59·1	1·90	48·3	1·53	38·9														

Long Tube. Short Tube.

Power.	35		30		35		40	
s and S = ∞	in.	mm.	in.	mm.	in.	mm.	in.	mm.
b and r	0·090	2·28	0·064	1·62	0·055	1·39	0·048	1·21
h	0·104	2·64	0·074	1·89	0·063	1·61	0·055	1·40
R	0·289	7·3	0·229	5·8	0·203	5·2	0·184	4·67
B	0·214	5·4	0·157	3·99	0·135	3·42	0·118	2·99
d'	0·379	9·6	0·295	7·5	0·258	6·6	0·231	5·9

Alternative values for b B and d' are given for the low powers in Table II. to enable them to be made for the Continental or No. 1 R.M.S. gauge of eye-piece.

For the formulæ upon which these eye-pieces are constructed, the reader is referred to the original paper.*

Eye-pieces on this construction are very suitable for the telescope; they give brilliant and sharp images upon a jet-black ground free from flare or ghosts of any kind.

Table II. contains a list of cheaper eye-pieces which satisfy the first two important conditions mentioned in the description of Table I.; but as the two lenses of which they are composed are plano-convex, their defining power will not be quite so sharp as those in Table I.

They will, however, give better results than the ordinary commercial Huyghenian eye-pieces, which are often far from perfect. The eye-pieces in both Tables should be "ringed," so that the diaphragm may be kept level with the top of the tube of the Microscope.† It should be borne in mind that the amount of over-correction in compensating eye-pieces, not only differs among those of different makers, but also among the compensating eye-pieces by the same maker; and as the same thing may be said with regard to the amount of under-correction in the objectives, be they achromats, semi-apochromats, or apochromats, of various makers, as well as in those by the same maker, it will be seen that it is by no means an uncommon occurrence to find the performance of a good objective ruined by the use of a compensated eye-piece not adjusted to it.

There are some achromatic objectives which perform better with compensating than with Huyghenian eye-pieces, and conversely, there are apochromats which perform better with Huyghenian than with compensating eye-pieces. For example, a semi-apochromat of exceptional excellence, corrected for the 6·3 in. tube, required a tube length of 4½ in. with a Huyghenian eye-piece; on the other hand, some very fine objectives would not come into adjustment at all with compensating eye-pieces, even when the tube was racked out to its full extent, say 12 or 13 in.! So in the first case one would be obliged to use a compensated, and in the second a Huyghenian eye-piece.

Tube-length correction is not altogether an alternative for over-correction in eye-pieces, nevertheless, if it is found that better results are obtained with Huyghenian eye-pieces, of proper construction, and tube-length correction, why use compensating eye-pieces?

* This Journal, 1900, p. 165.

† Powell was the first to maintain a uniform optical tube length by "ringing" his eye-pieces, and he has remained alone in this excellent practice. When he first began to do this is uncertain, but there is a Microscope of his of 1840 with "ringed" eye-pieces.

The fixity of tube-length and of magnifying power, which is made so much of in text-books, is a myth, because the actual power of an objective, or eye-piece, has nothing to do with the figures or letters engraved upon it, and every different object requires it own particular tube-length. Moreover, the identities are erroneous; thus, short-tube eye-pieces, powers 6, 8, 12, and 18, are equivalent to 9½, 12¾, 19, and 28½ long tube, and, conversely, 8, 12, 18, 27 long tube are equivalent to 5, 7½, 11⅓, and 17 short tube powers, so it is difficult to see where the enormous advantage which the text-books say arises from the "fudging" of the eye-piece comes in.

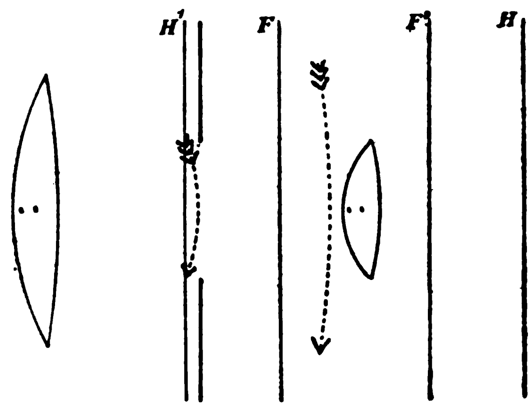


FIG. 86.

As stated above, I now seldom use compensating eye-pieces, preferring those of the form in Table I., and making the necessary corrections by the use of a rackwork draw-tube.*

It was pointed out † that vague notions concerning the action of the Huyghenian eye-piece were prevalent among microscopists on account of the incorrect figures and descriptions which have

* The first Microscope to possess a rackwork draw-tube was the large one made by Benj. Martin for George III., now in the Society's cabinet of ancient instruments. This draw-tube was made for the purpose of increasing the magnifying power. The second Microscope to have a rackwork draw-tube was a dissecting Microscope made by Oberhauser for Strauss Durkeim, and for the same reason.

But the first rackwork draw-tube, for the purpose of lens correction, was made by Messrs. Powell and Lealand to my order. And the first Microscope with a double draw-tube, one for lens correction and the other to enable the instrument to be used with objectives, corrected either for the long or short tube, was subsequently made by Swift to my order in 1884. I regret to have to draw attention to such a matter, but piracy in microscopical devices is especially rampant just now.

† This Journal, 1900, p. 163.

repeatedly, from 1830 onwards, been published in microscopical text-books. These figures represent the curvature of the objective image reversed by the field-lens of the Huyghenian eye-piece, whereas in reality it is increased in its original direction and not reversed at all. Fig. 86 shows what really takes place; the large dotted arrow represents the image due to the objective alone, and the small one shows in what way it is altered by the influence of the field-lens. One would have thought that a mistake such as that mentioned above would long ago have been corrected, because one would naturally have expected that the subject would have been explained in the text-books on geometrical optics, all of which deal with the Huyghenian eye-piece. The question, however, is evaded; true, the position of the image arising from the extreme marginal pencils is diagramatically indicated by arrows drawn perpendicular to the axis; this by itself is of small importance; what everyone wants to know, and what no text-book explains, is the relation of this point to that formed by the central pencil. If, for instance, the point where the central pencil cuts the axis, is nearer the field-lens than the position of the smaller arrow in the text-book figure, then the image is curved so as to be concave to the eye-lens, and therefore, the resultant image presented to the eye will be plane and well-defined at the edges, but if, on the other hand, this point is further from the field-lens than the smaller arrow, the image will be convex towards the eye-lens, and the final image will be indistinct at points not far from the axis. This second case is what actually takes place. So important is the subject, that I thought it worth the labour of making an exact trigonometrical trace of the excentrical pencil passing through the plano-convex field-lens of the 5-power Huyghenian eye-piece for the short tube as given in Table II; the only difference being that the diaphragm was slightly widened out, so that a pencil more divergent from the axis might be traced. It is not my intention to trouble you with the details of the work beyond mentioning that the limit of accuracy was carried out to the second decimal place of a second of arc, and the sides of the triangles were true to the eighth decimal place. By this means it was found that the focal point of the central pencil was 0·0403 of an inch farther from the field-lens than that of the excentrical. In brief, the image was curved, as is diagrammatically shown by the small arrow in fig. 86.

The diameter of the back focal plane of the objective was assumed to be 0·6 inch, which is about that of the Zeiss 24 mm. apochromat.

It will interest mathematicians to know that the trace of the second ray of the excentrical pencil only differed from that given by the intersection of a line drawn in the usual manner from the second Gauss point by 0·007 inch.

Of late it has been the fashion to belittle Gauss's theorem, and to dub it as "merely an approximation," but the above work shows that it is a very close approximation. It is altogether a magnificent working theorem, and one of the best ever devised.

Since the above was written, a figure of a non-achromatic Microscope has been found in Coddington, Part II. (1830) pl. xiii., fig. 190, which has its objective image, as influenced by the field-lens of a Huyghenian eye-piece, drawn with its curvature in the proper direction.

Unless the text describing this instrument is read, one is very apt to be misled by the figure, for, at first sight, it looks as if it were the representation of a Microscope of the Benj. Martin type, that has a biconvex lens to act as a back lens to front lenses of various powers, the eye-piece being of the Ramsden form, and the tube-length only 1½ in. The text, however, shows that this is not so. The eye-piece is a Huyghenian, with a double eye-lens, so that the lens which was thought to be the back lens of the objective is in reality the field-lens of the Huyghenian eye-piece.

This Coddington Microscope was made by Cary, who, for the sake of cheapness, disregarded Coddington's formulæ for the forms of the lenses, and made them all equi-convex. Nevertheless, the instrument performs better than any old non-achromatic Microscope I have tried. It is interesting to know that it was the last non-achromatic Microscope; an example is in the Society's cabinet. I have not been able to trace the author who first made the mistake about the curvature of the image in the Huyghenian eye-piece. It is found in a paper by Cornelius Varley in the Transactions of the Society of Arts, li. p. 189 (1838). In this paper Varley advocates the over-correction of the eye-piece, by making the field lens of flint-glass; and he also suggests a push-tube adjustment for the distance between the lenses, a device which has lately been reintroduced. The examples I have seen would probably destroy the image given by any Microscope objective.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Eggs and Egg-envelopes of Selachians.‡—H. Braus describes the eggs and egg-envelopes of *Hexanchus griseus*, *Heptanchus cinereus*, *Spinax niger*, *Acanthias blainvillii*, *Centrophorus granulosus*, and other forms. He also discusses the light which certain embryonic features, e.g. the external gills, throw on the relationships of Notidanidæ and Spinacidæ.

Development of Heart and Chief Blood-vessels in Megalobatrachus maximus.§—Petronella Johanna de Rooy has reached the following conclusions. The pericardium is formed one day before the heart, as a cavity between splanchnopleure and somatopleure. The endothelium of the heart is laid down in an embryo of twenty days as a group of cells derived from the splanchnopleure. The ventral endodermic diverticulum which has been repeatedly regarded as the matrix of the cardiac endothelium is the primordium of the thyroid. The cells unite to form a primitive cardiac vesicle, passing anteriorly into the first aortic arches, posteriorly into the omphalo-mesenteric veins. The blood is formed in the free mesodermic margin growing ventrally; cell-walls appear bounding the large corpuscles, each of which has a nucleus and many yolk-plates. When the omphalo-mesenteric vein comes into connection with the blood-islets, then blood-cells appear in the heart, but not earlier. The blood-islets spread on each side over the whole yolk, and posteriorly they unite from right and left (sub-intestinal vein). The latter arises from the constriction off of several yolk-vessels, which

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ S.B. k. Preuss. Akad. Wiss. Berlin, 1906, pp. 907–32 (8 figs.).

§ Jen. Zeitschr. Naturw., xlii. (1907) pp. 309–46 (6 pls.).

anastomose. All vessels, except the aorta, arise as spaces in the mesenchymatous mesoderm. The surrounding cells form the walls. The aorta arises from individually segregated mesoderm cells. Anteriorly these form two vessels, posteriorly they form one, lying under the subchorda. The anterior portion is established before the trunk portion.

Reactions of Vertebrate Embryos.*—S. Paton describes some of the primitive reactions of embryos of *Amphioxus*, various fishes, and amphibians to environment, to incident stimuli, and to metabolic processes. In relation to this there is given a general outline of the development of the nervous system at certain epochs, followed by a discussion of what seem to be the more important histological characteristics of these periods. In general it may be said that the functional activites of the body represented by the beat of the heart and the primitive movements of ab- and adduction of the body begin at a time when these phenomena may as yet neither be designated as myogenic nor neurogenic in origin. In the case of the heart it is not at all improbable that impulses may be conducted and even originate in the undifferentiated tracts of protoplasm which exist. Neurofibrils have an important bearing upon function. One of the chief histological characteristics of the fully differentiated nerve is that it contains neurofibrils, and all the evidence so far accumulated points to the appearance of these structures as marking the period of greatest physiological activity in any given nerve. A cell is not to be regarded as a nerve unless it contains neurofibrils.

Blastoporal Asyntaxy in Amphioxus.†—R. Legros discusses the significance of asyntaxic development and its bearing on the theory of concrescence. Material was found in embryos submitted to the action of chloride of lithium, and in embryos obtained after retarded fertilisation. He concludes that "asyntaxic development and normal development consist in the same total of the same cellular movements. The principles of the theory of concrescence find their rigorous verification in the method of closing of the blastopore and in the phenomena of organogenesis which accompany anachronic notogenesis in the asyntaxic embryos." He further regards it as demonstrated that the closing of the blastopore and formation of the archenteric roof in the normal *Amphioxus* are effected by concrescence.

Histolysis and Histogenesis of Muscles of Ant Queen.‡—C. Janet has followed the histolytic changes which occur in the vibratory muscles of the wings of ant queens after nuptial flight. Mesodermic free cells—true leucocytes—accumulate around the degenerating muscles, subsequently penetrating their envelopes. After penetration the leucocytes become adipocytes or adipogenic bodies, transforming the muscle substance into adipose tissue.

Histology and Function of Calciferous Glands in Lumbricus.§—A. Combault has made a histological study of these glands. He describes

* Mitt. Zool. Station Neapel, xviii. (1907) pp. 535–81 (3 pls.).
† Tom. cit., pp. 440–534 (2 pls. and 6 figs.).
‡ Comptes Rendus, cxliv. (1907) pp. 1070–3 (22 figs.).
§ C.R. Soc. Biol. Paris, lxii. (1907) pp. 570–2.

their structure, and concludes that they are respiratory in function. There are no glandular tubes or acini, and no excretory ducts. In both adult and embryo the tissue is that of a mesodermic vascular organ.

Structure of Mantle of Calyculina (Cyclas) lacustris, Müller.*—O. Schröder describes the histological structure of the mantle of *Calyculina*. The most interesting feature consists of slender threads which are seen in decalcified examples to stretch from the mantle epithelium to the periostracum across the space left by the decalcified shell. These threads clearly correspond to the small canals of the shell. They are prolongations of certain cells of the mantle epithelium. They are 3μ thick and in thickest parts of shell may be 60μ long. Externally they are enveloped by the same organic membrane which the nacre leaves behind on decalcification. Internally there is a delicate fibre, which is traceable basalwards to the nucleus of the cell.

Determination of Sex.†—F. H. Pike communicates a critical and statistical study on the determination of sex, with special reference to human offspring. In man there is a slight but constant excess of male births; the greater mortality of the males leads to a preponderance of females in old age. The proportion of the sexes is remarkably constant in widely different localities and times. The study of duplicate twins shows that if sex is determined by a series of accidental causes, such causes cannot be operative after the fertilisation and first segmentation of the ovum. "The logical conclusion from the statistical data is that sex is hereditary. Mendel's law does not apply. The constancy of the sexual ratio for more than two hundred years may best be explained by supposing that sex follows Galton's law of ancestral inheritance. If sex is hereditary, we may explain the significance of the sexual ratio on the basis of natural selection by supposing that the proportion of the sexes in any species is such as will give that species the maximum reproductive power at the time of sexual maturity of its individual members. The sexual proportion may be considered as one of the physiological adaptations of a species."

Spontaneous Generation.‡—M. Kuckuck finds that it is not very difficult to make little living creatures. Take a mixture of gelatin, pepton, asparagin, glycerin, and sea-water; sterilise it by boiling for an hour; put it in a sterilised vessel; and add a little chloride of barium. This brings about ionisation, and ionisation leads to organisation. Kuckuck thus obtained minute protist-like bodies, which feed and grow and rotate and form cell-colonies like morulæ. The drawings of these are indistinguishable from drawings of morulæ, and each cell has a very distinct nucleus. Some photographs are also submitted. Similar bodies were obtained from fresh albumin and from yolk of egg by using barium chloride as an ioniser. Drops of "natrium nucleinicum" (Merck) allowed to fall on the surface of the gelatin mixture produce rotating corpuscles, which form loose colonies. Kuckuck argues from his experi-

* Zool. Anzeig., xxxi. (1907) pp. 506–10 (2 figs.).
† Amer. Naturalist, xli. (1907) pp. 303–19.
‡ Die Lösung des Problems der Urzeugung. Leipzig (1907) 83 pp., 34 figs.

ments that the first organisms were non-nucleated Monera, that they arose in the sea by a process of ionisation from a mixture of organic and inorganic substances. The nucleated cell afterwards arose by the symbiosis of two aniso-electrical non-nucleated cytodes. Everything living has sex (negative and positive ions) and everything is living because it has sex.

Proportion of Sexes in Dogs.*—Walter Heape has investigated this subject in an exhaustive manner, having dealt with a total of 36,867 pups, the data being obtained from the "Greyhound Stud Book," the "Stock-keeper," "Kennel Register," etc. In interpreting the evidence brought out in the statistics, the author indicates that he is disposed to maintain: "(1) that through the medium of nutrition supplied to the ovary, either by the quantity or by the quality of that nutrition, either by its direct effect upon the ovarian ova or by its indirect effect, a variation in the proportion of the sexes of the ova produced, and therefore of the young born, is effected in all animals in which the ripening of the ovarian ova is subject to selective action; (2) that when no selective action occurs in the ovary, the proportion of the sexes of ovarian ova produced is governed by laws of heredity." The sex is determined prior to or at the moment of fertilisation.

Some of the facts made clear may now be given. Of the total number of pups (36,867) the proportion of dogs per 100 bitches is 117·49. Nearly 50 p.c. of these pups are greyhounds, with 118·5 dogs per 100 bitches. Collies, with 6777 pups, give the nearest to these proportions, viz., 118·19 dogs per 100 bitches. When the details of all the large dogs are abstracted, the proportions yielded by the total remaining breeds (11,846 pups) are 118·04 dogs per 100 bitches. Thus there is a very remarkable approximation in the proportion of the sexes produced by greyhounds and collies, or by greyhounds and the other large dogs taken as a whole. Terriers give the proportions of 114·16 dogs per 100 bitches, a difference of about 4. This is not a wide variation, yet the author thinks a more extensive series of data would only serve to indicate a distinct racial variation in the proportion of the sexes. Regarding greyhounds, during every month in a series of years there is a preponderance of dog-pups born, but during October to December, when the fewest pups are born, the proportion of dog-pups is at its highest. The conclusion is drawn that conception during August to November is specially favourable to the production of dog-pups among greyhounds under the conditions of breeding now practised, and this result is attributed to a selective action on the ova produced at this time. The returns for collies show no evidence that conception at any particular time of year affects the proportion of the sexes born. The popular belief that there is a tendency to prolonged gestation when the embryo is of the male sex is strongly supported by the returns of breeders of bloodhounds and other large dogs, in which it is shown that prolonged gestation is clearly associated with a greatly increased proportion of male pups born. The size of the litter has apparently nothing to do with the length of gestation.

* Proc. Camb. Philos. Soc., xiv. (1907) pp. 121–51.

Influence of Extraneous Forces upon Sex Proportions.*—W. Heape records the results of two sets of breeding experiments with canaries. There is a remarkable difference in the proportion of the sexes of the young birds in the two aviaries, which is consistent both in detail and in the totals. Such consistent variation, when considered in relation to the food supplied, and to the temperature and surroundings to which the birds were subjected, may be interpreted as evidence of the exercise of extraneous forces on the proportion of the sexes produced, and of selective action on the generative elements dehisced by the parent birds. The factors which mainly governed the results shown for the two aviaries were, for one set (termed G's birds) a temperature and aspect which conduced to early breeding, and the early maturation of ova which had not received specially rich nutrition. The generative functions of these birds were, in fact, "forced" without being richly fed, and they produced males in great excess. Tho other set (termed N's birds) were kept back, they both nested later and moulted later than G's birds, their generative functions were not stimulated, the ova matured more slowly and were at the same time more highly fed, and these birds produced a marked excess of females.

Mendelian Inheritance in Axolotls.†—V. Häcker has, in spite of various drawbacks, succeeded in two sets of experiments in effecting cross breeding between black and white races of Axolotl (*Amblystoma tigrinum*). In both instances the numerical relations corresponded with surprising exactitude to the Mendelian proportions 3 : 1. In spite of incomplete prevalence of the dominating character in the first hybrid generation, both races follow in the second generation the law of Mendel, and hence are to be included amongst the few zoological instances where this law can be demonstrated without too great difficulties.

Brain of Domestic Animals.‡—L. Lapicque and P. Girard, from a comparative study of the brains of wild and domesticated types of various species, find that domestication is associated with a diminished brain-weight relative to the total body-weight.

Fore-brain of Vertebrates.§—C. U. Ariëns Kappers and W. F. Theunissen have investigated the comparative anatomy of the fore-brain in Vertebrates, and in a preliminary paper discuss chiefly the phylogenetic significance of various structures and relations in the brain of *Petromyzon*, Holocephali, and Selachians.

Functions of Cerebellum.‖—H. Munk, in a second contribution on this subject, indicates that the specific function of the cerebellum is the more delicate preservation or regulation of balance in sitting, lying, standing, walking, and so on. The activity of the cerebellum stands in relation to these requirements. In the so-called resting stage it influences—like the other central organs of motor apparatus, the cerebrum,

* Proc. Camb. Philos. Soc., xiv. (1907) pp. 201–5.
† Zool. Anzeig., xxxi. (1907) pp. 99–102.
‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 1015–18.
§ Anat. Anzeig., xxx. (1907) pp. 496–509 (10 figs.).
‖ SB. k. Preuss. Akad. Wiss. Berlin, ii. (1907) pp. 16–32.

the spinal cord, etc.—medulla and muscle centres for the region of the vertebral column and extremities, exciting these centres more or less, but always only weakly.

Brain Development of Sexes in Twins and Triplets.*—H. Waldeyer found in three cases of twins of opposite sexes that the brain of the male fœtus in each case showed a more advanced stage of development. This was the case also in one instance of triplets; in two other instances of triplets this difference could not be recognised.

c. General.

Variation in the Dentition of the Dog.†—J. Kunstler and J. Chaine report a case where the upper jaw bore 4 regular incisors, so that the formula was $i\,\frac{4}{3}$, $c\,\frac{1}{1}$, $pm\,\frac{3}{4}$, $m\,\frac{3}{3}$. The authors refer to other cases in which 43, 44, 46 and 47 teeth have been recorded.

Skin of North Atlantic Whales.‡—Arnold Japha gives an account of the skin and skin structures of *Megaptera* and of *Balænoptera*. The integument consists of epidermis and sub-epidermal tissue corresponding to the cutis and sub-cutis of other mammals. In the sub-epidermal tissue there is the blubber layer with a thin upper stratum similar in structure to the corium of other mammals, but not entirely free from fat. The fat-cells of the blubber layer occupy the wide meshes of connective-tissue, and are very large. Elastic fibres are abundant. The upper surface of the sub-epidermal tissue rises into narrow ridges, arranged generally longitudinally, and whose structure varies in different species. On these ridges rest the elevated papillæ, containing almost the only blood-vessel loops which nourish the epidermis. The thickness of the epidermis varies with the species, and consists of five layers: a layer of small cubical cells at the bottom, next one of long spindle cells, a middle layer of large polygonal cells, one of flat spindle cells, and a horny layer. Horn is present, but neither keratohyalin nor eleidin could be demonstrated. The pigment in the coloured animals is confined to the epidermis, and occurs in two forms. It is present in all the layers of the epidermis, forming caps around the nucleus and as much-branched stellate chromatophores in the lowest layer. Sweat and sebaceous glands are absent. In adults hairs are constantly present in a definite arrangement on the head, but absent on the rest of the body. The hair papillæ are compound; moulting of the hair appears not to take place.

Lungs of Cetacea.§—F. E. Schulze has examined the lungs of dolphins and of two right-whales. In dolphins there is a remarkable development of cartilaginous framework extending into the respiratory parenchyma. On each of the surfaces of both sides of the relatively thick alveolar septs there extends a special respiratory capillary net. In the right-whales the cartilages do not extend so far into the respiratory

* S.B. k. Preuss. Akad. Wiss. Berlin, vi. (1907) pp. 114–26.
† Proc. Verb. Soc. Sci. Bordeaux, 1906, pp. 26–7.
‡ Zool. Jahrb. Abt. Anat., xxiv. (1907) pp. 1–40 (7 pls.).
§ SB. k. Preuss. Akad. Wiss Berlin, x. (1907) p. 203.

parenchyma. These are distinguished by the width of the alveoli. Atria in the sense of Miller were found in none of these Cetaceans' lungs.

Fossil Cetacean, Agorophius pygmaeus, Müller.*—F. W. True gives an interesting account of this fossil, based upon an excellent plate prepared more than fifty years ago by the Smithsonian Institution, and never published. The fossil itself, unfortunately, cannot now be traced. It is of interest, first as representing a very distinct genus, and secondly as representing a possible direct ancestor of the whalebone-whales. The author does not think there is much probability in the latter suggestion, which originated with Paul Gervais in 1871. It is a primitive form, and its association with *Squalodon* has much to commend it. It is not unlikely that some such form was the ancestor of typical *Squalodon* and *Squalodon ehrlichii*, which latter species appears to be intermediate between the two genera.

Ancestry of Lemurs.†—E. Trouessart ascribes to the Lemurs two distinct branches which are probably derived from a common stem: (1) those of Madagascar and the majority of the fossils of the phosphorites of Quercy, which have dilated tympanic bullæ; (2) those of Asia and Africa, together with the fossil *Necrolemur*, which have flattened bullæ. The former group has undergone a very complete evolution, at the same time preserving a very uniform organisation. It is quite evident they have reached a final stage of development in Madagascar. They are not to be reckoned as in the ancestral line of the Apes.

Migration of Birds.‡—Otto Herman has brought together a mass of opinion on this subject from numerous sources and arranged it in a very clear and convenient form. Its object is to promote the science of ornithophænology, to substitute for local detached observations, which are for the most part confined to the palæarctic part of Europe, international concerted observations. He proposes an international committee of ornithosystematicians, ornithobiologists, ornithophænologists, phytophænologists, and meteorologists. These shall draw up a plan of observation of migration, chiefly in respect of (*a*) uniformity of data, (*b*) uniform method of working up. The scheme originates with the Hungarian central office of ornithology.

Studies on Penguins.§—W. P. Pycraft communicates some interesting notes on the nestling and embryos of the Emperor and Adébe penguins collected by the naturalists of the 'Discovery.' The embryological evidence points conclusively to what the palæontological evidences hint at—that penguins are descended from birds which possessed full powers of flight. It is suggested that the Steganopodes represent a common ancestral stock, from which have descended the Sphenisci, Colymbi, and Turbinares, on the one hand, and the Ciconiæ,

* Smithsonian Institute Publications, No. 1694 (1907) 8 pp., 1 pl.

† Bull. Soc. Zool. France, xxxii. (1907) pp. 13–14. See also C.R. Soc. Biol. Paris, lxi. (1906) p. 712.

‡ Recensio Critica Automatica of the Doctrine of Bird Migration. Budapest, 1905, Royal Hungarian Ministry of Agriculture.

§ National Antarctic Expedition, ii. (1907) 28 pp., 1 pl. and 8 figs.

Accipitres, and Anseres, on the other. Like the Steganopodes (excepting the Phæthontidæ), the penguins have suppressed the external nares completely, except in *Spheniscus*, in which, however, they have ceased to be functional. In penguins, the sealing up of the nares has been brought about simply by the growing together of the rhamphothecal horny tissue surrounding the aperture, leaving the osseous nares unaffected. This peculiarity of closing the nares appears to have been the common heritage of all the forms belonging to the great Steganopod branch of the Avian tree, except the Colymbi. In their pterylosis, the penguins are the most primitive of all the Carinatæ, and, after them, the Steganopodes show the broadest pteryla. There can be little doubt that the primitive beak-sheath of penguins was composed of several separate pieces. Thus the deep lateral grooves point to distinct lateral plates.

A very remarkable fact is that the penguins develop two successive down plumages before assuming the normal definitive feathers. It would seem that the full sequence of plumages is represented by (1) neossoptyles, composed of (*a*) pre-pennæ (divisible into protoptyles and mesoptyles) and (*b*) pre-plumulæ; and by (2) teleoptyles, or definitive feathers. Another remarkable fact is that, in moulting, the feathers are not cast a few at a time, but over large areas the feathers lose all direct attachment to the body, and stand out therefrom at right angles or thereabouts.

Bird Mating.* — R. W. Shufeldt summarises the known facts regarding mating among birds. Mating habits appear to be independent of phylogenetic relationship. Birds are polygamists, monogamists, and in certain cases are given to practices simulating polyandry. At present we have no knowledge of the origin, causes, and, in the majority of cases, the needs of these various habits.

Genus Aramides.†—Outram Bangs publishes an account of the members of this genus of woodrails occurring north of Panama. In all species the sexes are alike in colour, and there are but slight individual or seasonal differences. Some species, *A. axillaris* and its allies, have a juvenile plumage, still worn when the bird is nearly fully grown, that is quite different in colour from the livery of the adults. Other species apparently do not have a young plumage that is very different in colour from that of the adults.

Marine Fishes of Southern California.‡—E. C. Starks and E. L. Morris give a list of 246 marine fishes occurring on the Californian coast, south of Point Conception and within the 50-fathom line. Distributional notes are given in all cases; there are many new and several amended descriptions of species.

United States Mammals.§ — E. A. Mearns has issued an exhaustive report on the mammals of the Mexican boundary of the United

* Amer. Naturalist, xli. (1907) pp. 161–75.
† Tom. cit., xli. (1907) pp. 177–87.
‡ Univ. Californian Publications, iii., No. 11 (1907) pp. 159–251 (1 pl.).
§ Smithsonian Institution, U.S. Nat. Museum, Bull. 56 (1907) 530 pp., 126 figs

States. The record (termed Part I.) comprises the orders Marsupialia, Edentata, Ungulata, and Glires; each species' description includes not only a very full structural account, often extending to internal characters, but also notes on the geographical range, type-locality, habitat, and habits. There is further embodied in the volume a general summary of the natural history, and a list of the trees on the Mexican boundary line.

Anatomy of Notoryctes typhlops Stirling.*—Georgina Sweet continues her researches on this subject. In the present paper she deals with the skin, hair, certain supposed tactile sense-organs upon the head and other regions, and the reproductive organs. Regarding the female organs in addition to the ovaries, oviducts, uteri, and vaginæ proper, there are described two lateral vaginal canals with vaginal cæca and a median vaginal apparatus. Like *Perameles*, as far as the female sex-organs can show, *Notoryctes* appears to be of a primitive type.

Caucasian Hedgehogs.†—K. A. Satunin records the occurrence of two hedgehogs not hitherto known in West Transcaucasia. These are described provisionally from three examples as *Erinaceus ponticus*, sp. n. and *E. ponticus abasaicus* sub-sp. n. Within the bounds of the Caucasus region there are now recorded four species or sub-species of the *E. europæus* L. group.

Paraganglia of Birds.‡—Wilhelm Kose gives a very full account of the histology of the paraganglia-chromaffin tissue of birds. The bulk of the memoir deals with this tissue in the carotid and supra-renal organs, but accounts of its presence in various other parts of the body are given. An extensive series of birds is dealt with.

Parietal Eye of Lizards.§—M. Nowikoff continues his account of histological and experimental researches on the parietal eye of *Lacerta agilis* and *Anguis fragilis*. Light effects, such as the burning of magnesium wire quite close to these animals when the lateral eyes were sealed, produced no movement. But such experiments proved nothing, since no response was shown when the lateral eyes were left uncovered. Histological research, however, reveals the fact of pigment movements adaptive to the regulation of light intensity. Further, there is an analogous behaviour of the pigment in both parietal and lateral eyes. These things the author regards as confirmatory of his view that the parietal eye in these lizards functions in the adult stage as an organ sensitive to light.

Osteology of Ichthyosaur from the Oxford Clay.‖—C. W. Andrews has gone fully into the osteology of *Ophthalmosaurus icenicus* Seeley, and gives a summary of his results, which includes a description of the skull,—remarkable for the immense relative size of the orbits,—vertebral column, ribs, girdles, and limbs. There appears to be an extraordinary degree of variability in the form of many of the bones, which is partly

* Quart. Journ. Micr. Sci., li., No. 202 (1907) pp. 325–44 (2 pls. and 1 fig.).
† Zool. Anzeig., xxxi. (1907) pp. 233–5.
‡ Arch. Mikr. Anat., lxix. (1907) pp. 563–790 (6 pls.).
§ Biol. Centralbl., xxvii. (1907) pp. 405–14.
‖ Geol. Mag., No. 515 (1907) pp. 202–8 (5 figs.).

real and partly apparent. The real differences appear due to the amount of cartilage persisting, and thus the actual form of the bones depends on the extent to which ossification had proceeded. The apparent differences are due to the pressure to which these bones have been subjected. This is particularly noticeable in the vertebræ, the centra of which may be shortened to nearly half their length without fracture or further distortion. These facts have been made clear only by a comparison of a number of skeletons.

New Species of Goby from the Mediterranean.*—J. Pellegrin and Louis Fage describe, from about 70 m. depth to the north of the Balearic Isle, Cabrera, a new species of goby, the first of the genus *Eleotris*, from the Mediterranean. Five examples were found measuring from 19 to 25 mm. One proved to be a mature female, so that these minute forms are to be regarded as adults. The new species is named *Eleotris balearicus*. M. Pruvot states that these small fishes were found amongst calcareous algæ, where also certain minute Annelids and other small species occur, and suggests that there is some relation between the algæ and the dwarfing of these forms of life.

Origin of Tactile Barbules in Genus Mullus.†—Salvatore Lo Bianco has traced the development of these barbules. Very clearly he shows how, by a gradual shifting forward and differential growth, the first pair of branchiostegal rays become transformed into the tactile chin barbules of the adult.

Tunicata.

Ascidians of Cape Verde.‡—J. Rennie and H. Wiseman describe the Ascidians collected by Cyril Crossland at Cape Verde. Although a fairly abundant supply of material was secured, it has not proved particularly rich in species. Ten forms were collected, two of which are new, viz. *Sarcobotrylloides parvum* and *Amaroucium crosslandii*.

Sense-organ in Salpidæ.§—F. Todaro describes a terminal organ of the lateral nerves corresponding to the nerve-buds in the lateral canals of fishes, as described by Leydig. This organ is situated dorsally at the right side of the brain and optic organ, anterior to the first pair of body muscles, and has been observed in *Helicosalpa virgola*, in *Salpa punctata*, and *S. maxima*.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Antarctic Histioteuthid.‖—W. E. Hoyle reports a larval histioteuthid, the only Cephalopod (apart from mandibles from the stomachs

* Bull. Soc. Zool. France, xxxii. (1907) pp. 11–12.
† Atti Reale Accad. Lincei, xvi. (1907) pp. 577–86 (8 figs.).
‡ Proc. Zool. Soc., 1906, pp. 903–11 (2 pls.).
§ Atti Reale Accad. Lincei, xvi. (1907) pp. 575–6.
‖ National Antarctic Expedition, ii. (1907). Mollusca. I. Cephalopoda, 2 pp. 1 fig.

of seals and penguins) obtained by the 'Discovery.' He communicates notes on the larval form by G. Pfeffer, who refers it to *Calliteuthis*.

3. Lamellibranchiata.

Malacological Fauna of African Lakes.* — R. Anthony and H. Neuville find that the malacological fauna of the lakes Rodolphe, Stephanie, and Marguerite is essentially fresh-water; there are no halolimnic forms as in lake Tanganyika, hence the authors find no authority for the extension of the Tanganyika hypothesis to these smaller lakes.

Phylogeny of Lamellibranchs.†—G. A. Drew discusses this subject. He concludes that ontogeny and the probable conditions that have resulted in the complication of structure both seem to indicate that the division of the Mollusca into Lamellibranchs and Gastropods took place at an early time before the ancestors had attained much complexity of structure. There seems to be no reason for believing that Lamellibranchs ever had more complicated head machinery than they have at the present time. If this is true, they probably have never needed ganglia more anteriorly than they now generally have.

Anatomy of Giant Scallop.‡—G. A. Drew describes the circulatory and nervous systems of *Pecten tenuicostatus*. Blood from the mantle is returned immediately to the heart. Most of the blood from other portions is carried to the kidneys, from which it passes to the gills and thence to the heart. A portion may avoid the kidneys and go direct to the gills. Blood seems to act both as blood and lymph. The cerebral and pedal ganglia are small, and somewhat removed from their usual positions. The visceral ganglia are very large and complicated in structure. The circumpallial nerves and the branchial nerves have ganglion cells throughout their length. The otocyst nerves originate directly from the cerebral ganglia.

Movements of Ensis directus Con.§—G. A. Drew has studied the habits of this razor-shell clam, which is abundant all along the eastern coast of the United States. It is an active animal, it burrows rapidly, and may also swim and leap. In burrowing, the foot is worked into the mud, the end is then swelled into a knob, and by its sudden withdrawal the shell is drawn to the position of the anchored end of the foot. Simultaneous with these actions a strong jet of water is thrown from the anterior end of the shell so that the mud is softened or even washed away as the shell descends. By a similar ejection of water from the anterior end of the shell the animal can swim backward by a series of jerks. By sudden protrusion of the foot, or by bending and suddenly straightening it, the animal is able to throw itself about on the bottom. Such movements are generally rapidly repeated when once begun.

* Comptes Rendus, cxliii. (1906) pp. 66–7.
† Biol. Bull., xii. (1907) pp. 239–43.
‡ Tom. cit., pp. 225–45 (7 pls.). § Tom. cit., pp. 127–40 (1 pl.).

Antarctic Bivalves.*—Edgar A. Smith reports on the collection of Lamellibranchs made by the 'Discovery.' It includes fourteen species, of which ten are new, e.g. *Kellia simulans*, *Philobrya limoides*, *Limopsis grandes*, and a beautifully sculptured *Lima*.

γ. Gastropoda.

Antarctic Pteropods.†—Sir C. Eliot reports on five species of Pteropods collected by the 'Discovery,' viz. *Limacina antarctica* Woodward, *L. retroversa* (Fleming), *Clio sulcata* (Pfeffer), *Clione antarctica* E. A. Smith, and *Spongiobranchæa australis* D'Orb. The two chief forms are *L. antarctica* and *C. antarctica*, which seem to be distinct from the corresponding northern species, though nearly related. The characters which the Arctic and Antarctic forms of *Limacina* and *Clione* present are compatible with any hypothesis which assumes that they are derived one from the other, or from a common ancestor. One Antarctic form, *Clio sulcata*, is closely allied to a cosmopolitan form, *C. pyramidata*, and may plausibly be considered as a special adaptation of it to Antarctic life. Also if *Limacina lesueuri* is admitted to be merely a variety of *L. retroversa*, then *L. retroversa* is cosmopolitan and bipolar. Is it not probable, then, the author asks, that *Clione antarctica* and *C. limacina*, plus some tropical forms of the genus, represent variations of a once cosmopolitan species? There is nothing unnatural in the idea that such a species may have undergone similar but not identical changes in the North and South Polar waters.

Antarctic Nudibranchs.‡—Sir Chas. Eliot reports on the 'Discovery' collection of Nudibranchs, which includes 12 species, 10 new. He establishes two new genera, *Tritoniella*, near *Tritonia*, but with a wide dorsal margin bearing, instead of foliaceous tufts, simple unbranched prominences, which have a few lamellæ on the under side, and *Galvinella* near *Galvina*.

Antarctic Chiton.§—Edgar A. Smith describes an interesting chiton (*Chætopleura miranda* sp. n.) obtained by the 'Discovery.' Its coloration is remarkable, the third and seventh valves being stained with red, the rest being dirty whitish. The same form has been simultaneously described by J. Thiele under the name *Notochiton mirandus* g. et sp. n. This specimen was obtained by the German Deep-Sea Expedition from Bouvet Island, which shows the wide distribution of the species.

Antarctic Gastropods.‖—Edgar A. Smith reports on the 'Discovery' collection, which includes 26 species, 21 new. The collection does not show any particular resemblance to the Arctic fauna, most of the genera having a world-wide distribution. The general absence of colour is characteristic. The most striking forms are *Trophon longstaffi* and a new genus *Trichoconcha*, with a flexible tough shell like a chestnut skin, and a beautiful hairy periostracum.

* National Antarctic Expedition, ii. (1907). Lamellibranchiata, 7 pp., 1 pl.
† Op. cit., iii. No. 6 (1907) pp. 1-15 (2 pls.).
‡ Op. cit., ii. (1907). Mollusca, IV., 28 pp., 1 pl.
§ Tom. cit., 1 p., 1 pl.
‖ Op. cit., iii. (1907). Mollusca, II., 12 pp., 1 pl.

Seminal Apparatus in Helix.*—A. Popovici-Baznosanu publishes a note on this subject. There are three distinct organs in this apparatus, viz. the seminal canal, the copulatory vesicle, and the diverticulum. The two first are always present, the third only in certain species. The species may be arranged in three groups: (1) where all parts are present and the diverticulum functions for the reception of the spermatophores; (2) where the diverticulum is absent; and (3) where it is reduced or absent in some examples. *Helix pomatia* is an example of a species which may or may not possess a diverticulum. Of examples from Paris, 25 per cent. had one, from Roumania 50 per cent., and from Banat 100 per cent. The conclusion is that in the third group of species, *Helix nemoralis*, *H. lucorum*, *H. pomatia*, etc., the diverticulum is a rudimentary organ.

Arthropoda.

a. Insecta.

South Orkney Collembola.†—G. H. Carpenter describes the Aptera collected by the Scottish Antarctic Expedition in the South Orkneys. There are three species, all referable to the family Entomobryidæ, two being members of the cosmopolitan genus *Isotoma*, and the third being referable to Willem's recently described Antarctic genus *Cryptopygus*. The two species of *Isotoma* indicate affinities of the apterous fauna of the South Orkneys to that of other Antarctic lands eastwards and westwards, as well as to that of the Arctic regions, and "even to that of the land whence the *Scotia* sailed." The distribution of these primitive wingless insects affords evidence for the discussion of the problem of ancient land connections. The facts established in this paper point to the former existence of extensive land tracts south of the American continent with connection either by way of Antarctica or of South Africa to Kerguelen. There is also a presumption of a former connection by way of America with the Northern continents.

Ecological Study of Sarcophagidæ.‡—W. B. Herms has made a study of the habits and life-histories of several Sarcophagidæ, which fed on beach debris at Cedar Point, Ohio. Their first impulse after drying subsequently to pupation is to seek food, which they detect rapidly. *Sarcophaga sarraceniæ* is rarely found in large numbers about a carcase, while the screw-worm fly is most abundant nearer the water and on larger carcases. *Lucilia cæsar* may be very numerous. *Lucilia* deposits its eggs in irregular masses on the softer portions of stranded fish where there is liquid food. This the adults suck while depositing eggs. The larvæ on emerging find themselves amongst suitable food. *Sarcophaga* deposits living young anywhere upon or near a carcase, thus leaving the larvæ to find suitable food. *Compsomyia*, the screw-worm fly, deposits very minute living young, but is careless about placing them upon fish. Under favourable conditions of food supply the larvæ reach full-growth in three days or less and then burrow into the sand, a short distance at

* Comptes Rendus, cxliii. (1906) pp. 70–2.
† Proc. Roy. Soc. Edinburgh, xxvi. (1907) pp. 473–83 (2 pls.).
‡ Journ. Exp. Zool., iv. (1906) pp. 45–83 (7 figs.).

first. During the night or when the sand is cooled, migration from beneath the remains takes place, the larvæ travelling 20 ft. or over, and again burrowing. The pupal period is quite regular, though differing with the species. Outlines of the several life-histories are detailed, and a number of facts are given with regard to the normal growth through larval and pupal stages, effects of over- and under-feeding, and other matters, as well as an account of several experiments on various tropisms.

Culex fatigans and Dengue Fever.*—P. M. Ashburn and C. F. Craig experimented with *Culex fatigans* reared from the egg, and found that these in one case, after being allowed to bite a dengue patient, subsequently communicated the fever to an individual isolated in a mosquito net who had not in any other way been exposed to the disease. The authors failed to find any organism either in the stomach or tissues of infected mosquitos which might be regarded as a stage in the life-cycle of a protozoon. They conclude that the dengue parasite is ultramicroscopic in size.

Diaposematism in Butterflies.†—F. A. Dixey gives an interesting account of diaposematism or interchange of warning characters between mimic and model in the case of *Huphina corva* and *Ixias baliensis* from the island of Bali. On the one hand *Huphina corva* mimics *Ixias baliensis* in the matter of a dark border on the hind-wing, whilst in the fore-wing the *Ixias* has departed from the usual aspect of its nearest relatives, becoming in this case the mimic while the *Huphina* stands as the model.

Cryptic Resemblance in South American Insects.‡—E. B. Poulton describes a moth *Dracenta rusina* Druce which bears a cryptic resemblance to a dead leaf partially destroyed by fungi, and a locustid *Plagioptera bicordata* from the same region which probably resembles a much bent or even rolled green leaf which has been attacked by a species of fungus.

Dimorphism of a Geometrid in relation to Mendel's Law.§—L. B. Prout reviews the results of certain extensive heredity experiments with the geometrid *Xanthorhoë ferrugata* (Clerck) from which he concludes that the colour dimorphism does not obey Mendelian law. If there is any co-relation at all between the colouring and gametic purity, it must be of so involved a nature as to baffle our present powers of discernment.

Physiology of Insect Metamorphosis.‖—S. Metalnikoff has investigated this subject experimentally. At the beginning of metamorphosis there appear in the blood of insects definite specific toxins which apparently lead to the poisoning of definite tissues and cells. By this means these fall victims to phagocytosis. It is not improbable that these toxins are strictly specific with reference to the different tissues,

* Philippine Journ. Sci., ii. (1907) pp. 93–152.
† Trans. Entom. Soc. London, 1906, pp. 521–4 (1 pl.).
‡ Tom. cit., pp. 533–8 (1 pl.). § Tom. cit., pp. 525–31.
‖ Biol. Centralbl., xxvii. (1907) pp. 396–405 (3 figs.).

muscle-cells, malpighian vessels, etc. It is also possible that they do not appear simultaneously, but in a definite order of succession. The definite order of the histolytic processes points to this.

Eyes of Diptera.*—Jan Zavrel has investigated the eyes of various larvæ and pupæ of Diptera. He finds that in *Sayomyia*, Chironomidæ, *Simulium*, there occur during development either two or three pairs of eye primordia. Since this phenomenon is repeated not only in single species but in whole and different families, it admits not of a biological but of a morphological interpretation. The facts support the theory of Radl of the duplicity or triplicity of the lateral Arthropod eyes.

Chermes of Colorado Conifers.†—C. P. Gillette gives an account of the members of this genus found on Conifers in Colorado. Some of the species are decidedly injurious to pines and spruces when used as shade trees in parks or private grounds. The males, in the United States at least, are unknown. Six species or varieties are dealt with, most of which are new, and much information is supplied regarding habits, host-plants, injuries and natural enemies, and life-histories.

Larvæ of South African Anophelina.‡—E. Hill and L. G. Haydon discuss the value of larval characters in species diagnosis, and find that in the case of nine species collected in Natal, the sum total of the characters is sufficiently pronounced to establish identity. They did not find any characters of specific value other than those set forth by Christophers and Stephens—viz. antennæ, frontal or clypeal hairs, thorax, palmate hairs. They describe the nine species identified and give notes on individual variations, habitat, seasonal occurrence, and relation to malaria.

Lead-Gnawing Insect.§—The "English Mechanic" records a case of a bug (so-called) which is the cause of considerable damage to the lead covering of underground telephone cables in Chicago stock-yards.

Distribution of Injurious Insects by Artificial Means.‖—F. V. Theobald recounts the various ways in which injurious insects are distributed by the agency of man, and indicates the origin, means of dissemination, and present distribution of a number of important insects attacking fruit-trees in orchards and gardens, and also of various animal pests. Dispersal as an accompaniment of human intercourse has taken place mostly from north and south towards the equator. Many temperate-climate insects live and flourish in sub-tropical and tropical climates, but the reverse only applies within certain narrow limits according to each species. It is unlikely that many tropical pests would persist in the warmer parts of Europe; an instance of such, however, is the yellow-fever mosquito, which has evidently spread from the central American states, and can live as far north and south of the equator as 48°. A sub-tropical species which is spreading into temperate regions

* Zool. Anzeig., xxxi. (1907) pp. 247–55 (13 figs.).
† Proc. Acad. Nat. Sci. Philadelphia, lix. (1907) pp. 3–22 (11 pls.).
‡ Annals Natal Govt. Museum, i. No. 2 (1907) pp. 111–57 (12 pls.).
§ English Mechanic and World of Science, No. 2201, lxxxv. (1907) p. 397.
‖ Science Progress, No. 1 (1906) pp. 58–72.

is the San José scale, *Aspidiotus perniciosus* Comstock. After an insect is introduced to a new country, rapid local distribution may follow by natural means. Legislation is the only effective means of stopping the introduction of injurious insects into a new country. One can never prophesy how an introduced insect may act in its new home. It is, therefore, essential to the well-being of mankind that this insect dispersal by artificial means should be dealt with universally in regard to those pests which attack farm and garden produce, stores, stock, and man, to save further loss and danger.

Studies on Blattidæ.*—R. Shelford adds to the number of known viviparous Blattidæ, describing forms (*a*) with eggs inclosed in a chitinous ootheca, which is retained in the brood-sac of the mother, e.g. *Oxyhaloa saussurei*, *Eustegasta micans*, etc.; and (*b*) with eggs inclosed in a transparent membrane also retained in the maternal brood-sac. In some, e.g. *Panchlora virescens*, the membrane is complete, in others, e.g. *P. viridis* and *P. nivea*, it is incomplete. A new genus, *Sphecophila*, symbiotic in the nest of the wasp *Polybia pygmæa* Fab. in French Guiana, is described, and a revised list of the Blattidæ in the Hope Museum, Oxford, previously described by Walker, is also provided.

American Species of Papirius.†—A. D. Jackson gives an account of the 13 American species of this genus of Thysanura. A characteristic which distinguishes *Papirius* from *Smynthurus* and *Dicyrtoma* (the other genera in the family Smynthuridæ) is the possession of four-jointed antennæ, with a short terminal segment. The insects are gregarious, living in dark shady nooks among decayed wood and leaves where there is some moisture. They are well protected by their colour, which is usually of a reddish tinge like the brown of decaying wood.

Museum Beetle.‡—A. J. Ewart makes a contribution to the physiology of the museum beetle, *Anthrenus museorum*, whose larvæ have been working terrible havoc in the National Herbarium at Melbourne. Its ravages are only kept in check by placing the portfolios of plants in a chamber impregnated with the vapour of carbon bisulphide for two or three days at regular intervals. Napthalin has no effect upon the larvæ. The most remarkable feature about the larvæ is their power of feeding on dry materials without any apparent supplies of water, though they contain about the same percentage of water (68·5–71·8 p.c.) as do the larvæ of allied insects. The water may possibly be chemical in origin, being derived from the carbohydrate food, and set free in the animal's body by the oxidation of the carbon in respiration. Experiments go to show that when the grubs are actively feeding and respiring, the oxidation of the carbon in their carbohydrate food sets free a certain amount of water, which, aided by the imbibed water from the plant tissues, suffices, if the latter is over 10 p.c. in amount, for the aqueous requirements of the grubs. Bacteria are abundant in the alimentary canal, and since these bacteria feed on the carbohydrate food, and oxidise

* Trans. Entom. Soc. London, 1906, pp. 487–519 (1 pl.).
† Ohio Naturalist, vii. (1907) pp. 159–77 (2 pls.).
‡ Journ. Linn. Soc. (Zool.) xxx. (1907) pp. 1–5.

its carbon under conditions where no transpiration of water as vapour is possible, a certain increase in the percentage of free water in the alimentary canal must be produced in this way. The grubs do not seem to have any power of condensing water vapour from the air.

γ. Myriopoda.

Structure of Julus.*—H. Krug gives an account of the external segmentation, the respiratory system, the alimentary tract, and the posterior growing area of *Julus mediterraneus* and other species.

Antarctic Halacaridæ.†—E. L. Trouessart describes an Antarctic variety of *Leptospathis alberti*, which differs slightly in size and proportions from the Arctic form. He supposes that the species will turn up in intermediate localities, and denies that it has any bearing on the "bipolarity theory," in which he has no belief.

δ. Arachnida.

New South African Tick.‡—W. F. Cooper and L. E. Robinson describe *Rhipicephalus phthirioides* sp. n., taken from a horse in Rhodesia. The female is quite a typical *Rhipicephalus*, but the male shows very remarkable modifications of the ventral chitinous plates or adanal shields, the caudal protuberance, and the form of the fourth pair of legs. If the male only had been found, it would apparently have justified the creation of a new genus to accommodate it.

Antarctic Pycnogonids.§—T. V. Hodgson reports on the large collection of Pycnogonids collected by the 'Discovery.' There are no fewer than 28 species, of which 23 are new, including representatives of 3 new genera, *Austrodecus*, *Austroraptus*, and *Pentanymphon*. It may be safely stated that the headquarters of the Pycnogonids is in the southern seas, where 63 species are now known to occur. Four genera are, as far as is yet known, confined exclusively to the Antarctic region. The "bipolarity theory" is affected only by a single species, *Colossendeis australis*, for of all the numerous species of this genus, *C. proboscidea*, from the north, and *C. australis*, from the south, stand apart from all the rest on account of their bodily form, and there can be no question that they are much more nearly related to each other than to any other members of the genus. The two species, as species are recognised nowadays, are perfectly distinct, but how is their present position at opposite ends of the earth to be accounted for? Another interesting form is *Rhynchothorax australis*, the only other species of the genus being found in the Mediterranean. *Austrodecus* is perhaps a close relation of *Tanystylum* Miers, and is a curious little form with a slender and elongated proboscis, like the snout of a weevil beetle, no chelifori, six-jointed palps, and small ovigers. *Austroraptus* is remarkable for its spurred body and the length of its legs. These two genera, *Austrodecus* and *Austroraptus*, belong, along with *Leionymphon*, which

* Jen. Zeitschr. Naturw., xlii. (1907) pp. 485–522 (3 pls. and 8 figs.).
† National Antarctic Expedition, iii. (1907). Acari, 6 pp., 1 pl.
‡ Journ. Linn. Soc. (Zool.) xxx. (1907) pp. 35–8 (1 pl. and 4 figs.).
§ National Antarctic Expedition, iii. (1907). Pycnogonida, 72 pp., 10 pls.

is re-defined, to the family Ammotheidæ, but no true member of the genus *Ammothea* was seen. The most interesting form is *Pentanymphon antarcticum*, which is abundant in circumpolar waters, and differs from *Nymphon* in having an additional pair of legs. At first this was thought to be a quite novel feature in the morphology of the Pycnogonida, but the Scottish expedition brought another and much finer species from the South Orkneys. This proved to be identical with *Decolopoda australis*, described by Eights in a forgotten paper some seventy years ago.

Genus Lycosa in Britain.*—F. P. Smith gives a useful diagnosis of the family Lycosidæ, with descriptions of the species of the genus *Lycosa* hitherto recorded in Britain, notes upon their known localities, and in some cases brief comments upon their habits.

Arachnological Notes.†—M. Vl. Kulczyński has revised the genus *Amaurobius* (C. L. Koch), *Cœlotes auctorum*, and gives an account of the European species in detail, together with a diagnostic key to both males and females.

ε. Crustacea.

Notes on Tardigrada.‡—James Murray gives a brief but instructive account of the Tardigrada adapted to the initiation of beginners with the study of the group. There are notes on habitat, habits, methods of collecting and of observation, form and structure, geographical distribution, and an account of the different genera, including a key for diagnosis. A useful bibliography is appended.

Antarctic Cumacea.§—W. T. Calman describes four species collected by the 'Discovery,' two of which are represented by solitary specimens. No Cumacea have been previously recorded from within the Antarctic circle. The forms described are *Leucon australis* sp. n., *Eudorella similis* sp. n., *Cumella australis* sp. n., and *Campylaspis verrucosa* Sars., *var. antarctica* n. The typical forms of the last-named species occur in the North Atlantic and the Mediterranean, but have probably a much wider range, perhaps continuous with the variety described.

Antarctic Amphipods.‖—A. O. Walker reports on fifty-three species collected by the 'Discovery,' of which eighteen are new. Forty-three genera are represented, of which four are new, viz. *Podoprionides* (among Lysianassidæ), *Proboliella* and *Thaumatelson* (among Stenothoidæ), and *Epimeriella* (Epimeriidæ). As in the Arctic Amphipods, the Lysianassidæ greatly preponderate in the number of genera, species, and individuals. It was quite the usual thing to take 10,000 to 30,000 specimens of *Orchomenopsis rossi* at one haul. The typical Gammaridæ are unrepresented. Some good instances of wide distribution are given. Thus, *Ampelisca macrocephala* is an abundant Arctic species, though

* Journ. Quekett Micr. Club, April 1907, pp. 9–30 (4 pls.).
† Bull. Internat. l'Acad. Sci. Cracov., Classe Sci. Math. et Nat., No. 6 (1906) pp. 417–74 (2 pls.).
‡ Journ. Quekett Micr. Club, April 1907, pp. 55–70 (1 pl.).
§ National Antarctic Expedition, iii. (1907). Crustacea, II., 6 pp. 1 pl. and 4 figs.
‖ Tom. cit. Crustacea, III., 38 pp., 13 pls.

found also in temperate seas; *Eusirus propinquus* and *Melphidippa macrura* have only been recorded before from the more northern waters of Norway; the ascidiicolous *Leucothæ spinicarpa* seems to be ubiquitous, and Walker finds no difference between those taken from the 'Discovery's' winter quarters and those from our own seas and from the tropical seas of Ceylon and the Maldives. Among the peculiar forms may be noted *Hyperiopsis australis*, belonging to a rare genus, *Thaumatelson herdmani*, which is the only known Amphipod with its telson set in a vertical plane; *Epimeria macrodonta*, with long curved and sharp teeth on the body segments, and *Iphimedia hodgsoni* so densely clothed with fine spines directed backwards that it has a shaggy appearance.

Antarctic Species of Nebalia.*—Joh. Thiele finds that all the Leptostraca collected by the 'Discovery' belong to one species, also obtained by the 'Valdivia' and the 'Gauss,' namely, *Nebalia longicornis magellanica*.

Antarctic Ostracods.†—G. Stewardson Brady found in fifty-seven gatherings made by the 'Discovery' (in a limited number of small and often similar areas) only nine species of Ostracods. Of these all but two are new, viz. *Conchœcia innominata*, *Cypridina glacialis*, *Philomedes antarctica*, and two other species of this genus, *Xestoleberis reniformis* and *Linocheles vagans* g. et sp. n. The new genus is one of the Cytheridæ, and differs from the typical forms in the greatly elongated and thread-like legs of the third pair, and in the abnormally formed copulatory plate of the male.

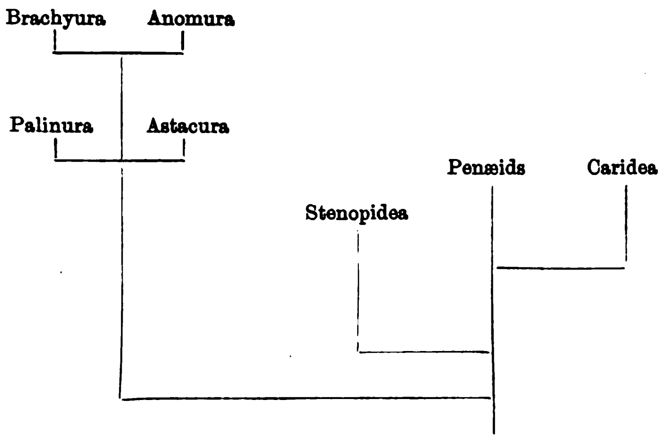
Antarctic Cirripeds.‡—A. Gruvel finds in the 'Discovery' collection the following forms: *Balanus psittacus*, *Elminius rugosus*, and two new species of *Scalpellum*.

Antarctic Decapods.§—W. T. Calman describes two species of Decapod Crustacea obtained by the 'Discovery' within the Antarctic circle, viz. *Chorismus antarcticus* (= *Hippolyte antarctica* Pfeffer) and *Crangon antarcticus* Pfeffer, both of which were also collected by the German Polar Commission of 1882–3 at South Georgia. With the exception of *Crangon capensis* Stimpson, which is very imperfectly known, *C. antarcticus* is the only species of the genus inhabiting the Southern hemisphere, and is widely separated from all the other species, which are confined to the temperate and (if *Sclerocrangon* be included) the Arctic regions of the Atlantic and Pacific.

Classification of Decapod Crustaceans.‖—L. A. Borradaile makes an important contribution to the taxonomy of the Decapod Crustaceans. A search for the most primitive group leads, beyond all doubt, to the Penæidea. From the original Decapod stock, whose nearest descendants are the modern Penæids, the Reptantia and Caridea must

* National Antarctic Expedition, iii. (1907). Crustacea, IV., 2 pp., 2 figs.
† Tom. cit. Crustacea, V., 9 pp., 3 pls.
‡ Tom. cit. Crustacea, VI., 4 pp., 1 pl.
§ Op. cit. ii. (1907). Crustacea, I., 7 pp.
‖ Ann. Nat. Hist., xix. (1907) pp. 457–86.

have arisen separately, and it seems probable that the former were the first to leave the early Penæid stem. The Stenopidea may be included along with the sub-order Natantia, i.e. as a tribe along with the tribe of Penæids, and the tribe of Carides. Within the Reptantia, the Brachyura and the Anomura stand out as natural groups. The Scyllaridea and Eryonidea may be classed as a single tribe of the Reptantia under the title Palinura, and the other division, that of the Nephropsidea, may be called Astacura. Thus the old Macrura are completely dispersed. A tree is given showing the general relationships. The possible evolution of the Caridea is also shown, and the author gives a very useful diagnostic key to the classification of all the Decapods.



Geographical Distribution of Crayfish.*—E. A. Andrews suggests a means of throwing light on the causes controlling the present distribution of crayfishes in North America. As is well known, on the west side of the Rocky Mountains all the crayfish belong to the genus *Astacus*, whilst elsewhere they are almost all of the peculiarly American genus *Cambarus*. As a contribution towards settling the question whether the conditions in the regions occupied by *Cambarus* are unfavourable to *Astacus*, he has transported females with eggs from Oregon to Maryland and successfully reared young in captivity to a size of 60 mm. Whether this species of *Astacus* can be introduced into eastern waters to compete with *Cambarus*, or to occupy regions free from *Cambarus* and to persist as a permanent addition to the fauna, remains for more extensive experiments to decide.

Autotomy of Crabs.†—H. Piéron finds that in *Grapsus varius* a gentle touch is sufficient to induce autotomy, and that as many as seven of the walking appendages may be thrown off in succession, but never more. The other three remain on, even though they be injured. Autotomy occurs also when the crabs are suspended, but in cases of

* Johns Hopkins Univ. Circular, n.s. No. 5 (1906) pp. 418–21.
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 863–4.

suspension when the ventral ganglia are separated from the œsophageal collar, it does not take place. The act may therefore be voluntary, but there is also a reflex autotomy.

New British Cladocera.*—D. J. Scourfield records from the neighbourhood of Scarborough *Alona weltneri* Keilhack, and *Pleuroxus denticulatus* Birge from Exminster, Devonshire. This latter form is typically American, and has not previously been recorded from this side of the Atlantic.

Differentiation in Regenerating Antennule of Asellus.†—C. Zeleny finds that in *Asellus* the differentiation of the segments in the proliferating cell-mass appears first at the base. This is followed soon by the appearance of segments at the tip; lastly they appear in the middle. The region of new growth is then located in one of the middle segments, differentiation proceeding on both sides of this. Growing antennules in young animals show the same method of development.

Behaviour of Larvæ of Cambarus.‡—E. A. Andrews gives an account of the behaviour of larval *Cambarus clarkii* and *C. diogenes* in association with the parent, and describes the structural relations of the attached larvæ. These larvæ associate with the parent in the first and second stages and in part of the third; this sort of family life is aided both by special recurved tips on the chelæ and by a peculiar telson thread, by means of which the larva is suspended from the mother until able to use its claws. Subsequently it holds on by these to the egg-stalk or to the maternal pleopods.

New Cypridina from Melbourne.§—F. Chapman describes *Cypridina thielei* sp. n. from Hobson's Bay, Melbourne, where it appears to be abundant. This form is remarkably phosphorescent; "inclosed in the live box, they were seen to emit a strong steel-blue light for about 10 minutes, and when the luminosity became faint it could be speedily increased by the application of slight pressure." The females of this species are probably natatory, though this appears to be exceptional in this genus.

Fresh-water Isopod from Calcutta.‖—T. R. R. Stebbing describes *Tackæa spongillicola* sp. n., found by Nelson Annandale in the canals of a sponge in a fresh-water pond at Calcutta. The hitherto known species of *Tachæa* are *T. crassipes* Schiödte and Meinert from coral-reefs at Singapore, and *T. incerta* H. J. Hansen, of unknown locality. The author is inclined to believe that *T. incerta* is not distinct from *T. crassipes*, and that *T. spongillicola* is a very near relation of the same species, distinguished chiefly by the terminal joint of the maxillipeds, but apparently also by having the limbs somewhat less spiny and the pleon shorter in comparison with the peræon. At some future opportunity it would be interesting to test by experiment whether the fresh-water form could support life in sea-water.

* Journ. Quekett Micr. Club, April 1907, pp. 71–6 (1 pl.).
† Proc. Indiana Acad. Sci., 1905, p. 159.
‡ Amer. Nat., xli. (1907) pp. 253–74 (2 pls.).
§ Proc. Roy. Soc. Victoria, n.s., xix. (1906) pt. 2, pp. 28–32 (1 pl.).
‖ Journ. Linn. Soc. (Zool.) xxx. (1907) pp. 39–42 (1 pl.).

Annulata.

Antarctic and Sub-antarctic Chætognatha.*—G. Herbert Fowler reports on three species of Chætognatha collected by the 'Discovery' south of 40° S., viz. *Sagitta hexaptera* D'Orbigny, *S. serrato-dentata* Krohn, and *Krohnia hamata* Möbius. In a collection made by the 'Challenger' he found the same species, with the addition of *S. zetesios* Fowler. He notes that *Krohnia hamata* ranges from 81° 30′ N. to 77° 49′ S., that *S. hexaptera* is pantothermal and cosmopolitan, and that *S. serrato-dentata* was absent at the colder stations of both 'Discovery' and 'Challenger.' It is not "bipolar," though found in sub-antarctic and north temperate seas.

Vascular System of Chætopods.†—Karl Fuchs has made an elaborate study of the blood-vascular system of Chætopods, with especial reference to Lumbricidæ and Arenicolidæ. In the former the system is strictly metameric: there are no vessels free in the cœlom, all are bound to mesenteries, septa, or the peritoneal coverings of gut and body-wall; the vascular layers are exclusively the sub-epithelial and sub-cœlo-epithelial limiting lamellæ; contractility is confined to the dorsal vessel and the pericorda. In Arenicolidæ the system is also strictly metameric; the two lateral vessels and the two sub-nephridials, and an unpaired sub-intestinal are distinctive additions as compared with Lumbricidæ; all transverse vessels are strictly intersegmental. A blood system is absent in Aphroditidæ, Glyceridæ, Capitellidæ, Polycirrinæ. The author discusses the intestinal vascular plexus or blood sinuses, the ventral vessel, the dorsal vessel, the connecting vessels and pericorda, the supra- and sub-œsophageals and intestinals, the extra-œsophageal, the sub-neural and extra-neural, the sporadic vessels, and shows how they are represented in the various families. Contractility is localised in the enteric blood-sinus and dorsal vessel, in the pericorda in Oligochæts and Arenicolidæ, in the circum-œsophageals of Opheliidæ, in the dorso-laterals of Cirratulidæ, in the ventro-branchials of Eunicidæ. The elaborate paper is finely illustrated.

Polian Tubes of Sipunculus.‡—F. Ladreyt has studied the histology and function of these bodies. There is a dorsal and a ventral differing histologically, especially in their ventral parts. Typically the polian tubes consist of a muscular layer and of an internal epithelium partly ciliated. In the anterior part of the tubes the ventral region is filled by strands of connective-tissue. In the meshes of this lacunar connective-tissue there is protoplasm with abundant nuclei. Here there are blood-corpuscles in different stages of development and of ciliated urns. The hinder section of the ventral polian tube is distinguished by the fact that in it degeneration processes go on both in the blood-corpuscles and phagocytes, as also in the connective-tissue elements. Brownish granules are formed which give uric acid reactions. The front part of the dorsal tube is lymphogenic, the posterior is excretory. From the latter uric acid

* National Antarctic Expedition, iii. (1907). Chætognatha, 6 pp., 1 chart.

† Jen. Zeitschr. Naturw., xlii. (1907) pp. 375–484 (12 pls. and 11 figs.).

‡ Arch. Zool. Expér., Notes et Revue, 1905, pp. 215–22. See also Zool. Centralbl. xiv. (1907) pp. 105–6.

passes to the body-cavity, thence by the kidneys to the exterior. Hence the polian tubes in *Sipunculus* function as hæmolytic, lymphogenic, and excretory organs.

Sex Phenomena in Protodrilus.*—Umberto Pierantoni has found some new species of *Protodrilus*, and from amongst the known forms has established a number of facts regarding sex phenomena in this genus. The sexual organs occupy the region immediately following the segments containing the salivary glands. In a very few cases they co-exist with the salivary glands in the anterior segments. The eggs usually arise from ovaries, like those of other Annelids, in connection with the cells of the somatic peritoneal investment or of the septa. In a few species the eggs may arise from the splanchnopleure. In such cases there are no true ovaries, but isolated eggs at various parts of the body. The testes, which occupy the segments behind the salivary region, are not dissimilar to those of Chætopoda. The spermatogenesis is described. Hermaphroditism is normal in *Protodrilus*, but in every species a few individuals occur which have spermatozoa alone in the posterior segment. These individuals may be considered as complementary males. They may occur throughout the whole period of sex maturity. Liberation of the sex-products takes place by dehiscence of the posterior segments. Self-fertilisation takes place in the water but not within the body-cavity. The sperms are liberated in groups and become detached only in the water in the hermaphrodite forms.

Morphology of Dinophilus conklini sp. n.†—J. A. Nelson describes this new form, which is known only in the aquaria of Pennsylvania University. There are 6 segments in the body, the cephalic bands are interrupted dorsally, there is a circumanal band, and the anterior pair of nephridia is complex. The metamerism is well indicated by the body-wall and its mucous glands, the nephridia, and the nervous system. In the structure of the first pair of nephridia and of the nervous system there are marked indications of a tendency to cephalisation. Close affinities with Chætopod Annelids are evident.

Distribution of Chætognatha.‡—C. A. Kofoid discusses the possible significance of the facts of horizontal and vertical distribution of Chætognatha as far as these are known. Coincident distribution of related species appears to be a widespread phenomenon amongst these pelagic organisms. Isolation is not likely to be a factor here in the evolution of species, but it is a question whether couples of coincident species, e.g. *Sagitta furcata* and *S. planctonis* are not merely the extremes of an environmental series beginning in the warm surface waters and ending in deep waters of lower temperature.

Nematohelminthes.

Case of Human Trichinosis.§—C. Remy describes the case of a man, aged 45, who was accidentally discovered on the operating table to be suffering from trichinosis. The infected muscles, which otherwise

* Mitt. Zool. Station Neapel, xviii. (1907) pp. 437-9.
† Proc. Acad. Sci. Philadelphia, lix. (1907) pp. 82–143 (2 pls.).
‡ Amer. Nat., xli. (1907) pp. 241–51.
§ C.R. Soc. Biol. Paris, lxii. (1907) pp. 985–7.

appeared normal, contained about 25 cysts to the square centimetre. These cysts were yellowish white, ovoid, about one-third mm. in size, granular, and contained spirally coiled trichinæ. The patient had never eaten raw pork, and had no knowledge of the infection.

Occasional Nematode Parasites of Man.*—R. T. Leiper has found amongst material obtained in the post-mortem room of the Kasr-Ainy Hospital, Cairo, specimens of *Ascaris mystax* Zeder, whose normal host is the cat, and of *Ascaris marginata* Rudolphi, normally occurring in the dog. An examination of these species by special methods has led the author to establish two distinctly new genera; *Belascaris* to include amongst others, *Ascaris mystax* Zeder, and *Ascaris triquetra* Rudolphi; *Toxascaris*, including *Ascaris leonina* v. Linstow, and *Ascaris marginata* Rudolphi.

Development of Ascaris in Artificial Media.†—L. Jammes and A. Martin have experimented with the eggs of *Ascaris vitulorum* in various media. Some of their results may be quoted. Injected into the sub-cutaneous connective-tissue and muscles of guinea-pig they may in the first 14 days reach the morula stage. Temperature is important, since similar experiments with cold-blooded animals failed. At 33° C. morulæ developed in distilled water in 12 days, and mobile embryos at the end of the 18th day. One of the authors succeeded in infecting himself. In weak acid (HCl) solutions at 33° C. development proceeded rapidly so that by the 6th day embryos were moving within the shell. In a corresponding alkaline solution at the same temperature the results were unsatisfactory, only a few morulæ and many broken eggs remaining after 10 days. By changing from the acid solution after a time to the alkaline, the embryos developed and left their shells.

Antarctic Nematodes.‡—O. v. Linstow describes the Trematodes of the Scottish Antarctic Expedition. From Weddell's seal (*Leptonychotes weddelli* Lesson) there are three species, two of which are new, and the third, *Ascaris osculata* Rud., is known from a variety of hosts in both Arctic and Antarctic regions. Several other species, including a free-living form, *Thoracostoma setosum* v. Linstow, are recorded.

Antarctic Echinorhynchus.§—J. Rennie describes, from the stomach of a Weddell Seal (*Leptonychotes weddelli*) taken by the Scottish National Antarctic Expedition at the South Orkneys, an interesting new species, *Echinorhynchus antarcticus*. This form is remarkable in shape, resembling the bowl of a pipe with a short stem. It is spiny along the upper side only, and has distinctive features in the rostrum. There is unusual sexual dimorphism in the fact that the males appear to be larger than the females.

Antarctic Free Nematode.‖—O. von Linstow describes *Leptosomatum australe* sp. n., the largest known free-living Nematode, the female attaining a length of almost 50 mm., the male 37·7 mm. As

* Brit. Med. Journ., 1907, pp. 1296–8.
† Comptes Rendus, cxliii. (1906) pp. 67–70.
‡ Proc. Roy. Soc. Edinburgh, xxvi. (1907) pp. 464–72 (2 pls.).
§ Tom. cit., pp. 437–46 (2 pls.).
‖ National Antarctic Expedition, iii. (1907). Nematodes, 4 pp., 1 pl.

the free Nematodes do not fall into any of the three groups Secernentes, Resorbentes, and Pleuromyarii, von Linstow proposes a fourth group of Adenophori. They have narrow lateral lines, with nucleated cells and without a longitudinal vessel. If there is an excretory pore, it is the opening of a ventral gland.

Platyhelminthes.

Cestode Studies.*—Al. Mrázek gives as the first of a series of Cestode studies an account of Cysticercoids from *Lumbriculus*. He describes *Aploparakis crassirostris* Kr., *Anomotænia pyriformis* Wedl., and two undetermined species of *Cysticercus*.

Antarctic Cestodes.†—Arthur E. Shipley describes the three species of Cestodes brought back by the naturalists of the 'Discovery,' all of which were found living together in the stomach of Ross's Seal. They are *Dibothriocephalus antarcticus* (= *Bothriocephalus antarcticus* Baird), *D. Scotti* sp.n., and *D. Wilsoni* sp.n., "a very attractive little tapeworm of few proglottides." It is remarkable that the only Cestodes brought back were got in the stomach of one rare animal, and that they belong to one genus. It seems more than likely that the Pleurocercoid stages will be found—if ever they be found—in the tissues of one of the Cephalopods.

Tænia nana in Belgium.‡—E. Malvoz records having found 31 cases in three years of infection with this parasite. The cases occurred amongst miners examined for ankylostomiasis. *T. nana* is a very slender and fragile Cestode, small, and not easily obtained entire. It does not appear to have an intermediate host.

Notes on Two Avian Cestodes.§ — T. B. Rosseter discusses the structure and systematic position of *Tænia nitida* Krabbe and *T. nitidulans* Krabbe. It appears that the morphology and physiology of these worms coincide specifically with Blanchard's diagnosis of the genus *Hymenolepis* Weinland, and are analogous with the type specimen *H. diminuta*. They are therefore now transferred to this genus.

Trematodes of South American Fishes.‖—E. v. Daday has revised the material upon which C. M. Diesing based his monograph of the genera *Amphistoma* and *Diplodiscus*, with the result that several new genera and species have been established. A discussion of the histology of the different species is included in the paper.

Trematode Parasite of Rana esculenta.¶—Paul Kopczynski gives an account of the structure of *Codonocephalus mutabilis* Dies. This parasite occurs inclosed in a small, yellowish-white, round capsule of about 2–3 mm. diameter in the body-cavity and musculature. Of 83 *Rana esculenta* investigated, 44 were found to harbour this parasite.

* Zool. Jahrb. Abt. Syst., xxiv. (1907) pp. 590–624 (2 pls. and 7 figs.).
† National Antarctic Expedition, iii. (1907). Cestoda, 6 pp., 1 pl.
‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 602–3.
§ Journ. Quekett Micr. Club, 1907, pp. 31–40 (2 pls.).
‖ Zool. Jahrb. Abt. Syst., xxiv. (1907) pp. 469–590 (6 pls.).
¶ Tom. cit., pp. 625–54 (1 pl. and 5 figs.).

Revision of Distomid Family Hemiuridæ.* — A. Looss gives a preliminary communication on this subject, in which he outlines the characteristics of the family and its genera. He limits the family to the typical Hemiuridæ—i.e. those forms which possess a retractile hind body, or at least, which agree fully with these in the main features of their organisation. In this arrangement, the genera *Derogenes*, *Accacœlium*, *Eurycœlium*, etc., admittedly closely related, are excluded, though included in Luhe's definition of the group.

Bilharzia of Cattle in Sumatra.†—A. Vryburg states that in the blood of the liver of cattle in Deli-Sumatra, bilharzia are often to be found. During life there are no indications of illness and they are hence found only accidentally. They occur also, usually few in numbers, in the blood of the mesenterial vessels. In a zebu killed on account of old age and blindness, 150 were found in the liver blood and 13 in the vessels of the gut. From a consideration of the size and appearance of the males and of the eggs, the species is probably *Schistosomum spindalis* Montgomery. The Sumatra females are smaller, but the two types are probably the same.

New Turbellarian from Hawaii.‡—Harold Heath describes *Planocera hawaiiensis* sp. n., from the Auau Channel, Hawaii, where the depth is 28–43 fathoms. The largest specimen is 39 mm. long and 33 mm. wide. The species is colourless, or with faint black blotches and streaks on the dorsal surface. There are five lateral and one anterior intestinal branches which anastomose frequently. The penis carries three kinds of hooks or spines, some of large size. These appear to be cuticularised papillæ —not, as Lang maintains for *P. graffii*, modified epithelial cells.

Incertæ Sedis.

Antarctic Brachiopods.§—Edgar A. Smith describes two species collected by the 'Discovery,' *Magellania fragilis* and *M. sulcata*, both apparently new. The former is very closely related to *M. kerguelenensis* of Davidson and to the Patagonian *M. venosa* of Solander; the latter is remarkable on account of the concentric sulcations and the coarse perforations of the shell. The author does not know of any recent form that exhibits sulci or marked lines of growth of this kind, but among fossil forms a similar kind of surface ornamentation is met with in *Terebratula sulcifera* Morris of the lower chalk.

New Cephalodiscus.‖—W. G. Ridewood gives an account of a new species of *Cephalodiscus* (*C. hodgsoni*) and of *C. nigrescens* Lankester, both obtained by the 'Discovery.' In the former the tubarium is an irregularly branching tube, with lumen varying in size, but with inner surface smooth, and not with partial septa and trabeculæ; the ostia are oval, about 3·3 by 2·3 mm., with four or five long radiating spines, simple or forked; the polypides are colourless, or nearly so, with no

* Zool. Anzeig., xxxi. (1907) pp. 587–620.
† Centralbl. Bakt. Parasitenk., xliii. (1907) pp. 806–9 (1 pl.).
‡ Proc. Acad. Nat. Sci. Philadelphia, lix. (1907) pp. 145–8 (1 pl.).
§ National Antarctic Expedition. ii. (1907). Brachiopoda, 2 pp., 4 figs.
‖ Tom. cit., ii. (1907) 67 pp., 7 pls. and 17 figs.

black or brown pigment; males, females, and hermaphrodites (with one ovary and one testis) occur mixed in the same colony, and are indistinguishable externally; there are twelve plumes, each with a terminal bulb, in the epidermal cells of which are refractive colourless beads; free eggs, about 0·45 mm. in diameter, are found in the cavity of the tubarium.

The author compares the six known species, gives a diagnostic key, and discusses the relations between *Rhabdopleura* and *Cephalodiscus*. He proposes the new sub-generic title *Idiothecia* for those species, e.g. *C. nigrescens* and *C. levinsensi*, in which the polypides reside in separate tubular cavities in the tubarium, and *Demiothecia* for those in which the polypides live together in the same cavity. The "problematical body" of Harmer is shown to be formed of obliquely interlacing cross-striped muscle-fibres. The clear refractive beads in the end-bulbs of the plumes of *C. hodgsoni* are regarded, not as rhabdite cells, but as the material of the tubarium in process of secretion, after the manner of the globules of mucus in a goblet-cell.

Rotatoria.

Digestion and Excretion of Chlorophyll in Rotifers.* — P. de Beauchamp has studied the digestion of chlorophyll-granules by Rotifers, when fed with green flagellate organisms, such as *Euglena*. The chlorophyll is at first absorbed by the cells of the stomach, then undergoes a gradual change from green into brown, and forms a layer of brown granules of angular shape in these cells. These granules, which resist the action of acids, but swell and are slowly dissolved by strong potassium hydrate, finally congregate in each cell in a mulberry-shaped mass within a kind of vacuole, and are thus expelled into the stomach-cavity. The chlorophyll, therefore, is not absorbed into the organism, but separated and expelled by the stomach-cells, and this curious and characteristic process appears to be constant in all Rotifers. The author then shows that substances other than chlorophyll are also excreted in the same manner by the stomach-cells. It is seen, therefore, that the stomach of Rotifers, consisting of a single layer of similar cells, is able to sort out the substances it absorbs, rejecting at once some in the form of granules with acid reaction, and retaining others as reserve material in the form of slightly alkaline proteid and fat globules.

Notommata (Copeus) cerberus Gosse.†—P. de Beauchamp gives a fuller description of this Rotifer, at the same time removing it from the genus *Copeus* in which Gosse had placed it, for reasons fully set out. The author figures the large auricles, which Gosse had not seen, and describes in particular the contractile vesicle of the excretory system as forming the posterior part of the intestine, separated only from the latter by a constriction, and provided with vibratile cilia, which are never seen in the normal contractile vesicle of other species. The lateral canals issue in a single trunk from this vesicle, which is really a cloaca, since the oviduct also opens into it. This arrangement

* Comptes Rendus, cxliv. (1907) pp. 1293–5.
† Zool. Anzeig., xxxi. (1907) pp. 905–11 (3 figs.).

exists in the Bdelloïds and some Rhizota, but has not yet been described in any of the Ploïma. The trilobed brain-sac of Gosse is naturally referred by the author to his retro-cerebral organ previously described; the very much smaller real brain, lying underneath, is not readily seen.

Echinoderma.

Development of Ambulacral Appendages in Holothuria floridana.* C. L. Edwards has studied the order of appearance of the tentacles, pedicels, and papillæ in *Holothuria floridana* Pourtalès, formerly identified as *Mülleria agassizii* Sel. During the fourth day the embryo has a primitive symmetry of four tentacles. During the fifth and last day within the vitelline membrane the embryo buds out a fifth tentacle. On the fortieth day a sixth tentacle develops, on the seventy-fifth day the eleventh appears. Their precise positions are noted. The first pedicel has budded from the posterior end of the mid-ventral radial canal on the fourth day; on the ninth day a second arises; on the twenty-second day a third appears; and so on.

Genus Heliaster.†—H. L. Clark has studied the starfishes of this genus, which are of more than usual interest because of their limited geographical distribution, their exclusively littoral habitat, and the large number of rays which they possess. Seven species are dealt with, including *H. polybrachius* sp. n., with 31–43 rays. The question of the succession of rays in development is discussed. As to systematic position, it is shown that the relationship with *Asterias* is very close, the only important differences being in the number of rays, the degree of their coalescence, and the resulting modification of the actual skeleton and arrangement of pedicels. It seems that *Heliaster* is intermediate between *Asterias* and *Labidiaster*, and, on the whole, it looks as if *Labidiaster* had originated as an offshoot from *Heliaster*, living in colder and deeper water, while *Odinia*, and perhaps *Brisinga*, too, are probably similarly related to *Asterias*. "Of the factors which have led to the development of the diverse forms of *Heliaster*, one at least stands out so clearly that there can be little doubt of its importance, and that is isolation."

Hermaphroditism of Strongylocentrotus.‡—G. Gadd records an instance of hermaphroditism in *Strongylocentrotus drœbachiensis* O. F. Mül., in which there was found to be one male gonad, while the others were female. This condition, it appears, is remarkably rare in Echinodermata.

Cœlentera.

Minute Structure of Nephthyidæ.§ — H. Reinhart has studied *Lithophytum thyrsoides* and *Dendronephthya maxima*, and gives a welcome account of the minute structure. He brings out some interesting minute differences between *L. thyrsoides* and other species, e.g. as to the mesenteric filaments. In the gullet of *D. maxima* there are two kinds of

* Science, xxv. (1907) pp. 775–6.
† Bull. Mus. Comp. Zool. Harvard, li. (1907) pp. 25–76 (8 pls.).
‡ Zool. Anzeig., xxxi. (1907) p. 635.
§ Jen. Zeitschr. Naturw., xlii. (1907) pp. 347–74 (1 pl.).

glandular cells, and cnidoblasts were found in the endoderm. Testes and ova were found close together on the same mesentery. The ova of *L. thyrsoides* (160–200 μ in diam.) are surrounded by a follicle of endoderm-cells, which forms internally a fine lamella. The spherical testis has a diameter of 160 μ, including the follicle. All the species of *Lithophytum* seem to have abundant symbiotic Algæ, but none were found in *Dendronephthya*.

Caligorgia flabellum from Port Philip.*—S. J. Hickson notes that what he named† as *Primnoella australasiæ* Gray (obtained at Port Philip) was really *Caligorgia flabellum* (Ehrenberg).

Wrightia coccinea.‡—E. S. Russell gives a description and figure of this hydroid which he found at Millport. It was first described by T. S. Wright in 1861, under the name *Atractylis coccinea*, but it must be assigned to the genus *Wrightia* Allman (1872). The hydranth makes an obtuse angle with the stem, and is closely invested up to the bases of the tentacles by a hydrothecal expansion of the perisarc, into which, however, it is not retractile. The gonophore resembles in structure that of *Garveia nutans*. It is pointed out that *Wrightia* and allied genera have a marked resemblance to Calyptoblasts in having a protective cup for the hydranth and a single verticil of filiform tentacles surrounding a conical hypostome. The Bougainvilliidæ may form a transition stage between the sub-orders Gymnoblastea and Calyptoblastea.

Antarctic Hydroids.§—S. J. Hickson and F. H. Gravely report on the 'Discovery' collection of hydroid zoophytes, which includes 25 species. Twenty-three of these represent the hydroid fauna of the most southerly limit of our knowledge of marine zoology, for only two species in the collection were found outside the limits of MacMurdo Bay and the edge of the great ice barrier. Ten species are certainly new, and five more are probably new, which is a very large proportion in a collection of 25. There is no definitely new generic type. Three species occur which are common on the British coast. The most interesting and remarkable form is *Hydractinia dendritica* sp. n.

Tentacles of an Antarctic Siphonophore.‖—John Rennie makes a note on the long tentacles of a Siphonophore, each of which, "as stout as an ordinary bootlace," seems to have been nearly 20 feet long. Hodgson gives a graphic account of the difficulties attending their capture.

Antarctic Alcyonarians.¶— S. J. Hickson describes *Ceratoisis spicata* sp. n., an important connecting link between the groups of species formerly separated into two genera, *Ceratoisis* and *Primnoisis*. The latter name should now disappear. Another new discovery is *Primnoella divergens*, which links *Primnoella* and *Caligorgia*. The other

* Proc. R. Soc. Victoria, xix. (1907) p. 46. † Op. cit., ii. (1890) p. 138.
‡ Ann. Nat. Hist., xx. (1907) pp. 52–5 (1 fig.).
§ National Antarctic Expedition, iii. (1907). Hydroid Zoophytes, 34 pp., 4 pls.
‖ Op. cit. 1907, 3 pp., 5 figs.
¶ Op. cit., iii. (1907). Alcyonaria, 15 pp., 2 pls.

forms in the collection are *Clavularia frankliniana* Roule, *Alcyonium pæssleri* May, *Ceratoisis* (*Primnoisis*) *delicatula* sp. n., *Ceratoisis* (*Primnoisis*) *antarctica* (= *Isis antarctica* Studer), *Thouarella antarctica*, and *Umbellula carpenteri* Kölliker, the only Pennatulid.

Plumulariidæ of Lamarck's Collection in Paris.*—A. Billard has revised this collection, and gives in the present paper an account of the doubtful or insufficiently described specimens of the family Plumulariidæ.

Morphology of Cœloplana.†—J. F. Abbott provides a welcome addition to our knowledge of this organism. His facts are derived chiefly from a study of a Japanese form of Kowalevsky's *Cœloplana*. It cannot swim either as a Ctenophore, or by means of the flattened skirt of the body, as some Planarians do. In the aquarium it usually adhered to the surface film by the ventral face of its body like a Planarian. It does not crawl in any one direction more than another; indeed, upon appropriate peripheral stimuli two sides of the animal may be made to progress in opposite directions. The animal is very fully described, and the conclusion is drawn that the weight of the morphological evidence supports the assumption that *Cœloplana* is a very highly specialised Ctenophore, related to or derived from the Cydippida. But its true position and relationship with other groups cannot be decided until its development has been worked out. Material for this has yet to be obtained.

Porifera.

Antarctic Sponges.‡—R. Kirkpatrick reports on the 'Discovery' collection of sponges, which includes 4 species of Tetractinellids, 43 Monaxonellids, and 24 Calcarea. No horny sponges were found. Three new genera of Hexactinellids (Rossellidæ) and 8 new species are described.

Protozoa.

Antarctic Tintinnidæ.§—H. Laackmann describes briefly the new species of Tintinnidæ obtained by the German South Polar Expedition. Of these there are 14; of known members of this family only one species is represented in the collection, *Tintinnus acuminatus* (var. secata?) This group, next to Diatoms, constitutes the most important constituent of Antarctic Plankton.

Mitochondria and Sphæroplasts of Infusoria.‖—E. Fauré-Frémiet finds, by the aid of special cytological methods, that certain spherular elements in the cytoplasm of Protozoa are what he terms individualised organites—constituent parts of the cell on the same level with the nuclei, centrosomes, and leucites. These he terms sphæroplasts. Infusoria possess a mitochondrial apparatus made up of sphæroplasts, constant cellular organs, individualised and multiplying by bipartition at the moment of division of the protoplasmic body. They are very distinct from the ergastoplasmic forms, which are temporary, as may be observed

* Ann. Sci. Nat. Zool., v. (1907) pp. 319–35 (5 figs.).
† Zool. Jahrb. Abt. Anat., xxiv. (1907) pp. 41–70 (3 pls. and 7 figs.).
‡ National Antarctic Expedition, 1907. Porifera, 25 pp., 7 pls.
§ Zool. Anzeig., xxxi. (1907) pp. 235–9 (13 figs.).
‖ C.R Soc. Biol. Paris, lxii. (1907) pp. 523–5.

in Vorticellidæ in the form of grains of the secretions saphranophile and siderophile. On the other hand, the mitochondrial apparatus of Infusoria is not unconnected with the chromidial apparatus to be found in many Protozoa. Sphæroplasts constitute a sort of cytoplasmic chromidium entirely independent of the nuclear, although its evolution is parallel to it. There is a synchronism in the phenomena of bipartition.

Encystation of Trypanosoma grayi.*—E. A. Minchin describes stages of encystment of *Trypanosoma grayi* as observed in the proctodæum of an infected tsetse fly. He regards these as similar to the "Schleim-Cysten" described by Prowazek in *Herpetomonas muscæ-domesticæ*, and that they are destined to pass from the fly along with its dejecta. Most probably in this case they contaminate the food or drink of a vertebrate host, develop in its digestive tract and pass thence into the blood, whence they are again taken up by the tsetse fly.

New Trypanosomes.†—Marchoux and Salembeni describe *Trypanosoma Borrelli* sp. n., from *Hyla lateristriga*. It is clearly distinct from *T. rotatorium*; it has no free flagellum, and differs in shape in the young stages from that of the adult condition.

Gustave Martin‡ records from a lizard, *Mabuia raddonii*, in French Guiana, *Trypanosoma boueti*. It is very rare and resembles *T. rotatorium*. The flagellum hardly projects beyond the body.

Life-cycle of Trypanosoma gambiense.§—J. E. Salvin-Moore and Anton Breinl are of opinion that the so-called male and female trypanosomes of Prowacek, Minchin and others are more likely to be arbitrarily chosen extremes in a continuous series of dimensions. They find that, in inoculated rats, as the number of parasites is increasing there is only amitotic fission of micro- and macro-nuclei. At the maximum stage from 5–20 per cent. of the trypanosomes show a thick stainable band growing out from the micro-nucleus and extending towards the macronucleus. This is quite distinct from, and thicker than, the stainable margin of the undulating membrane. At this stage micro- and macronucleus thus become connected. Later, when the number of parasites in the blood is falling off, trypanosomes in the bone marrow, and spleen disintegrate, the flagellum and remains of micro-nucleus becoming detached. Around the nucleus there has previously formed a definitely bounded hyaline area; these together remain intact, undergo no further change, and form "resistant" bodies. During the negative period of infection, they appear to decrease in size, but at the time of the reappearance of the trypanosome in the blood, they enlarge, the nucleus buds off a small micro-nuclear granule, and from this, at a later stage, there grows out a flagellum, and small trypanosomes result. Thus it appears that *Trypanosoma gambiense* has a life-cycle complete within the body of one animal, as is the case with the parasite of dourine; this suggests that contagion may be effected by a mere mechanical transmission of blood.

* Proc. Roy. Soc., Series B, lxxix. (1907) No. B 528, pp. 35–40.
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 592–4.
‡ Tom. cit., pp. 594–6. § Lancet, 1907, pp. 1219–20.

Movements and Structure of Spirochætes.*—H. B. Fantham has studied *S. balbianii*, from the oyster, and *S. anodontæ*, from the fresh-water mussel. The motion of these Spirochætes appears to be resolvable into at least two components: (1) a vibratory motion of flexion of the body, mainly for progression; and (2) a spiral or corkscrew movement of the body as a whole, due to the winding of the membrane. The corkscrew motion is especially well seen in the case of *S. anodontæ*, which has pointed ends. These Spirochætes seem to move more quickly than trypanosomes, and with an added corkscrew motion. Also the body of a *Spirillum* seems more rigid than that of a Spirochæte in motion, while flagella are present in the case of true *Spirilla*. Both these Spirochætes possess a spirally wound membrane, which is a lateral extension of the ectoplasmic periplast, and is composed of longitudinally arranged "myoneme" fibrillæ. The myonemes set up transverse movements in the surface of the body, manifested as waves passing down the body in a direction opposite to that in which the organism moves. Regarding the so-called "ciliate" (flagellate) stages in Spirochætes described by some authors, the apparent flagella or cilia are really "myoneme" fibrils split off from the membrane during its rupture. The flagella are never seen during life.

Sporozoon Parasite of Ciona intestinalis.†—F. van Gaver and P. Stephan explain that the so-called pericardial body of *Ciona intestinalis* is the product of a sporozoon parasite. In very young *Ciona* this body consists of desquamated muscle fibres inclosing fairly long fusiform elements which are apparently immobile. In older *Ciona* these elements become rounded or irregular, vary in size, and are inclosed in a granular mass from which the pericardial body derives its cohesion. This parasite, which is fully described, has vacuolar protoplasm, and a single or a small number of nuclei. Its exact nature has not yet been determined; the authors designate it *Cardiosporidium cionæ*.

Life-history of Pansporella perplexa g. et sp. n.‡—E. Chatton outlines the life-history of *Pansporella perplexa* g. et sp. n. The vegetative amœboid stages are found in the mid-gut of *Daphnia*. After being evacuated they reproduce by sporulation within a cyst. The spores are bi-nucleated and have a cellulose membrane; their maturation is accompanied by autogamic sex-phenomena. The affinities are very enigmatic.

New Haplosporidian Genus in Daphnia.§—E. Chatton records from the reptile tank in the museum of Paris, *Daphnia pulex* and *D. magna* infected with a sporozoon parasite, whose effects are fatal. The parasite is localised exclusively in the epithelium of the mid-gut, which it fills, completely killing the host. It is a form in which the ripe plasmodium fragments into a certain number of pleurinucleated elements. The sporulation of this parasite *Caullerya Mesnili* g. et sp. n., is described. The form falls to be placed between the families Haplosporidiidæ and Cœlosporidiidæ.

* Ann. Nat. Hist., xix. (1907) pp. 493–501.
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 556–7.
‡ Bull. Soc. Zool. France, xxxii. (1907) p. 13. See also C.R. Soc. Biol. Paris, lxii. (1907) 3 pp. § C.R. Soc. Biol. Paris, lxii (1907) pp. 529–31.

Culture of Bovine Piroplasma.*—M. Miyajima has made cultures with a bovine piroplasma which is common in Japan, and finds that a variety can readily be cultivated outside the living body. The parasites undergo developmental changes in blood-bouillon, and finally take the form of a typical trypanosoma. This trypanosoma cannot be detected in the blood of infected animals.

Schizogregarines of Sipunculids.†—L. Brasil and H. B. Fantham give some notes upon two species of Schizogregarines which occur at Roscoff and Luc-sur-mer in *Phascolosoma vulgare* Blainv. and in *P. elongatum* Kef. They belong to the family Selenidiidæ. They live free in the digestive tube or fixed in its epithelium. They are vermiform, and mobile like the *Selenidium* of Polychætes. The two extremities are acuminate, and the surface is marked by longitudinal striæ. The number and disposition of these striæ are distinct in the two species. The gut forms are all gametocytes. Schizonts are lodged in the deeper layers of the intestinal epithelium. Here they form oval cysts projecting slightly into the cœlome. Each contains from 30–40 merozoites, often fairly regularly arranged. The gametocytes themselves are often parasitised by the sporozoa which are common in the *Selenidium* of Polychæts.

Myxosporidian from Kidney of Proteus.‡—H. Joseph describes from the kidney tubules of *Proteus* a new Myxosporidian, *Chloromyxum protei*. The youngest stages, which have two or more nuclei, occur mostly in the ciliated cells. The host-cells hypertrophy and become detached, falling into the lumen of the tubules, where they disintegrate and liberate the parasites. In the larger parasites the nuclei multiply till the whole cell is fully occupied; here the nuclei are relatively larger and less readily stainable. In the pansporoblasts there arise drop-like inclusions which may become numerous and cover the nuclei. These are regarded as degeneration products, inducing a breaking up of the plasma with consequent liberation of the spores.

Myxosporidian Parasite of Flounder.§—S. Awerinzew finds that *Lymphocystis johnstoni* Woodcock is probably referable to the genus *Henneguya*, and he therefore provisionally names it *Henneguya johnstoni* Woodcock. It appears to occur in about 11 p.c. of *Pleuronectes flesus*, occurring at Murman. An account of its spores is given.

Myxosporidia of the Gall-bladder in Fishes.‖—S. Awerinzew discusses several Myxosporidia from the gall-bladder of fishes. In particular he describes *Ceratomyxa ramosa* sp. n. from the halibut. It is distinguished by branching and at times anastomosing pseudopodia in its trophozoite stage. The spores resemble those of *C. sphærulosa* in size. On account of convergence occurring in the matter of spore structure, their characters are of secondary value in classification.

* Philippine Journ. Sci., ii. (1907) pp. 83–91 (3 pls.).

† Comptes Rendus, cxliv. (1907) pp. 518–20.

‡ Arch. f. Protistenk., viii. (1907) pp. 398–412 (2 pls.). See also Zool. Centralbl., xiv. (1907) pp. 100–1.

§ Zool. Anzeig., xxxi. (1907) pp. 881–4 (5 figs.).

‖ Tom. cit., pp. 831–4

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Chromosome Structure in Plant-cells.*—V. Grégoire has examined the roots of *Allium* with special reference to the structure of the chromosomes both in the state of rest and of division. The author draws the following conclusions from his investigations: (1) At the end of anaphase the daughter-chromosomes crowd round the pole, but without fusing; later on they separate, but are united at certain points. The chromosomes undergo a gradual vacuolisation, so that the complete network is a network of networks. During prophase this network forms a series of spongy bands, which later on become homogeneous ribbons; the latter usually split longitudinally before metaphase, although the splitting may be deferred. (2) The chromosome element consists of an achromatophile substratum bearing a chromatophile substance. This latter is not in the form of corpuscles, neither can granules be distinguished. During the later resting-stages, a granular appearance is seen, but this is due to a massing together of the chromatophile substance, and not to independent granules. There is no reason for believing that there are any such independent granules either in the resting condition or during mitosis. (3) Longitudinal division consists in the splitting of the chromosome ribbon, and not in the separation of morphological units. (4) The chromosomes enter the quiescent network independently during telophase, and leave it independently during prophase. Everything points to the independence of the chromosomes.

Nuclear Division in Spirogyra.†—J. Berghs has investigated the nuclear division in *Spirogyra*, with the purpose of discovering a general scheme which will include the method of nuclear division both in the higher and lower plants. The author finds that the nuclear network is not chromatic, neither does it share in chromosome-formation. The nucleolus contains all the chromatic elements, and does not disappear during nuclear division. It has no membrane. The nucleolus is of a twofold nature, and gives rise to twelve chromosomes which divide lengthwise and are arranged in an equatorial ring, while another substance of a different nature remains unchanged and preserves the form

* La Cellule, xxiii. (1906) pp. 311–56 (2 pls.).
† Tom. cit., pp. 55–86 (3 pls.).

of the nucleolus. During anaphase, this substance divides into two groups of rods which pass to the poles, and to each rod two of the true chromosomes become attached. The nucleus is reconstituted at the expense of the rods and chromosomes; vacuolisation occurs, and a nucleolus is formed by condensation, and during this process the rods and chromosomes lose their separate identity. The nuclear membrane is nothing but a peripheral layer of protoplasm. The nuclear network is gradually re-formed during telophase. The spindle of *Spirogyra* is purely cytoplasmic, the fibres being formed outside the nucleus and penetrating into its interior.

Structure and Development.

Vegetative.

Tracheids of Wood of Conifers.*—W. Krieg has studied the stratification of the tracheid-membranes in the Coniferæ, and finds that it chiefly occurs in the "red" wood of the horizontal branches, and is confined within the annual ring to the autumn wood. It depends upon an internal differentiation of the membrane into alternate thicker and more delicate layers, and the markings always run obliquely to the left. The fissure-formation is not identical with the striping, but is dependent upon it. The spiral thickening is not an internal differentiation, but a local thickening of the innermost membrane-layer in the form of spirals, rings, etc. All markings, spiral thickenings, and pit-formations are the product of living plasmas, but their physiological significance is at present unknown.

Comparative Anatomy of the Polemoniaceæ.†—G. Hüller gives an account of his investigations of the leaf, pollen, and testa of the Polemoniaceæ. As regards the leaf, several of the species, including the genera *Cantua* and *Cobæa*, have stomata only on the under side, but both sides are usually thus provided; in *Phlox Hordii* alone are they more numerous on the upper side. There are no subsidiary cells. As regards the mesophyll, the bifacial arrangement occurs in *Bonplandia*, *Cantua*, *Cobæa*, and species of *Gilia*, *Phlox*, etc., the centric in other species of *Gilia* and *Phlox*, and in two species each of *Collomia* and *Loeselia*. In *Phlox longifolia* and certain species of *Gilia* the mesophyll has water-storage tissue in which the nerves are imbedded.

The midrib in some cases (species of *Gilia*, *Collomia*, *Loeselia*, and *Phlox*) has single bundles of sclerenchyma, or small groups of such, lying either in the xylem or the phloem, or above or below them; in others there is a semi-lunar mass of sclerenchyma below, and a complex of sclerenchyma bundles in contact with the leptome or above the xylem. Two anomalous types of midrib structure are met with; in a few cases (species of *Gilia* and *Phlox Douglasii*) a large mass of sclerenchyma separates the leptome into two islands, and this is carried further still in other species of *Gilia*, the xylem and phloem being divided into several

* Beih. Bot. Centralbl., xxi. (1907) pp. 245–62 (4 pls.).
† Tom. cit., pp. 173–244 (1 pl.).

small portions. The parenchyma sheath is usually conspicuous and large-celled; in *Phlox amœna* and *P. Drummondii* it takes the form of an endodermis, its numerous cells having cuticularised radial and tangential walls, while in *Gilia pungens* its cells are woody, with U-shaped thickenings.

Usually the pollen is spherical; it is ellipsoidal in most species of *Collomia* and a few of *Gilia*, and polyhedral in *Collomia aristella*. It is honeycombed in *Cobœa*, *Phlox*, some species of *Collomia* and *Gilia* and a few others; smooth in *Gilia latifolia*; has wavy ribbing in species of *Collomia* and *Gilia*; meridional ribs in *Collomia grandiflora*, *Gilia* sp., and the Polemoniums except *P. mexicanum*; and is warted in *Bonplandia*, *Cantua*, and *Loeselia*.

The testa is three-layered—(1) epidermis, (2) compressed layers, (3) pigment layer—in many cases. In *Cobœa* it is of four layers, lignified cells being interposed between (1) and (2), while in *Loeselia* and *Gilia* sp. the lignified cells are replaced by mechanical tissue. The testa of *Phlox* has only layers (1) and (2). In all genera except *Phlox* the epidermis cells swell up when moistened; they are thickened in most cases with spiral bands or rings. The slimy matter lies outside the spiral in *Bonplandia*, *Cantua*, *Cobœa*, *Collomia*, and a few more; in the rest it lies within the spiral thickening.

Ruellia and Dianthera: an Anatomical Study.*—T. Holm has studied two species of Acanthaceæ very common near Washington, *Ruellia ciliosa* Pursh. and *Dianthera americana* L. The former has the monostelic stem-structure characteristic of most Dicotyledons; in the latter the interesting discovery is announced of its possession of a polystelic axis. *Ruellia ciliosa* has root-shoots belonging to Wittrock's second or "additional" type. These have a cortex of three zones; a peripheral zone of thickened cells with cystoliths; a middle or thin-walled cell with some thick-walled sclerotic cells and cystoliths, but without raphids and starch; and a typical endodermis. Within is the pericambium which surrounds the mestome with its stereome, the latter presenting itself as four strands outside the leptome. In the latter raphidines are very rare, and never more than one in a cell. The above-ground stem has collenchyma surrounding a cortex with cystoliths and raphids, but no sclerotic cells and no starch. The mestome strands are collateral, and there are a few cambium-layers between leptome and hadrome, but none outside the medullary rays. The pith has raphids and crystals of various forms, but neither starch nor cystoliths. In the leaf the mechanical tissue is present only in the form of hypodermal strands of thick-walled collenchyma, there being no stereome. Water-storage tissue occupies the greater part of the midrib above and below the mestome bundles; these are all collateral, those forming the midrib being arranged in a broad arch, concave upwards; the leptome consists of several groups under the hadrome, and also occurs as small isolated strands between the hydromic rays. Endodermis is present on the leptome side only; it forms an open arch, like that found by Roulet in species of *Thunbergia*.

* Bot. Gazette, xliii. (1907) pp. 308–28 (2 pls.).

The rhizome of *Dianthera americana* bears many secondary roots, showing adaptation to aquatic conditions. There is a three-layered exodermis, and a thin-walled cortical parenchyma of many layers. The stele shows a thin-walled endodermis, a continuous pericambium, and very distinct cambium arches inside the leptome. Cystoliths, sclerotic cells, and crystals are absent, but a few raphidines were found in the leptome of some of the roots. The polystelic structure of the stem is somewhat obscured in the nodes owing to anastomosing of some of the steles. In the rhizome the epidermis overlies a continuous zone of very thick-walled collenchyma, followed by the cortical parenchyma containing starch and raphids, but no chlorophyll. Its horizonal internodes have six peripheral steles and one central, each being surrounded by thin-walled endodermis containing starch. Inside the endodermis are a few thick-walled stereome cells, but they do not form a sheath. In the peripheral steles the leptome and hadrome form an almost complete ring with a small central pith, whereas the mestome of the central stele is arranged in two arches with a broad parenchyma in the middle. Raphidines are abundant in the leptome. Similar structure, with slight variations in correspondence with the change in environment, is found in the aerial stem. In the nodes of the latter, four of the peripheral steles (two on each side) unite to form two large triangular steles, from which the two leaves arising from the node receive each three mestome cylinders, whereof the central may sometimes be absent. Strangely enough, the axillary shoots which are inflorescences are monostelic in structure. Strong evidence is adduced tending to show that the roots studied by Greenish as those of *Phlox carolina*, really belonged to *Dianthera americana*. This disposes of the statement that cystoliths occur in the roots of the former.

In view of Van Tieghem and Douliot's proposal to resuscitate the genus *Auricula* on account of its polystelic axis, the author hints that a similar step may possibly be taken hereafter in respect of the polystelic species (three in number) of *Dianthera*. It would be interesting to note whether the pollen partakes in these structural differences.

Reproductive.

Embryology of Rhytidophyllum.*—M. T. Cook has made a comparative study of *R. crenulatum* D.C. and *R. tomentosum* Mart., and finds that, while the two species have distinct, external differences, the morphology of the embryo-sac and embryo is the same. The archesporium is a subepidermal cell which develops directly into the functional megaspore. There is nothing unusual in the formation of the embryo-sac, and the embryo is of the *Capsella Bursa-pastoris* type, with slight variations in the dermatogen-formation and in the basal region. The endosperm is cellular, and formed in the usual way, but is soon disorganised. Both endosperm and nucellus feed the embryo, and finally the latter is only surrounded by endosperm.

* Bull. Torrey Bot. Club, xxxiv. (1907) pp. 179–84 (1 pl.).

Physiology.

Nutrition and Growth.

Aerial Roots of Aroids.*—K. Linsbauer has experimented with the aerial roots of Aroids, with special reference to their growth and geotropism. The author finds that usually the nourishing roots have a very long zone of growth. The compensating roots which develop in consequence of the wounding of such roots behave similarly to an ordinary root. The length of the zone of growth of an attaching root is considerably less than that of a nourishing root. The relative rate of growth of a nourishing root is less than that of an attaching root. The daily growth of the nourishing and attaching roots is not greater than that of ordinary earth-roots. The typical nourishing roots of the Aroids are generally positively geotropic, but their geotropism is not very marked, for they may retain a horizontal position for days at a time. Many nourishing roots under favourable external conditions are either entirely or periodically ageotropic. Typical attaching roots are usually ageotropic. Nourishing and attaching roots, as long as they are growing, bear statoliths in the well-marked columella of the root-cap, and this character is independent of their geotropism.

Hybridisation of Wild Plants.†—D. T. MacDougal records the results of observations of hybridisation among oaks. The author finds that only under very exceptional conditions can the facts of geographical distribution be relied upon to furnish evidence as to the origin of a species or hereditary quality. Synthetisation, when successful, gives reliable conclusions as to the composition of a hybrid, but failure to produce a hybrid may be due to reciprocal crossing, or to difference in physiological attributes. While cultural tests of the progeny of a hybrid will furnish no evidence as to origin, if the progeny exhibits alternate inheritance, there will be unmistakable signs of the nature of the original cross.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Ferns of Brazil.‡—H. Christ publishes an account of the pteridophytes collected in San Paulo by the Brazilian expedition of the Imperial Academy of Science at Vienna. The specimens come from the rain-forests and the open plain, and are mainly hygrophytic, some from the plain being xerophytic. A small number also were obtained from the plateau of Minas Geraes and the Serra d'Itatiaya; these are decidedly xerophytic. The entire collection comprises 304 Filicineæ and 15 Lycopodieæ, 23 species being new to science. The author, discussing the question of fern distribution in Brazil, points out that South Brazil and especially the dry highlands of Minas form an important endemic

* Flora, xcvii. (1907) pp. 267–98 (2 pls.).
† Bot. Gazette, xliii. (1907) pp. 45–58 (4 figs.).
‡ Denkschr. k. Akad. Wiss. Wien, lxxix. (1906) 53 pp. (9 pls.).

centre. The influence of the Andine flora upon that of the eastern mountains and plateaux is remarkable. There also was in the past a streaming out of the neotropic ferns to Africa as far as the Mascarenes; but this can hardly be said to have been reciprocated in the reverse direction. Brazil is almost free from the influence of the Eastern hemisphere. Mexico has certain affinities with Asia and Europe, certain species even reaching so far as Ecuador and the Southern Andes. A bibliography of Brazilian fern-literature is supplied.

G. Hieronymus * describes the collection of *Selaginella* made by the same expedition, one of the ten species enumerated being new.

Ferns of Tropical America.—G. Hieronymus † publishes the second part of his paper on the pteridophytes collected by Dr. Alfons Stübel on his journeys in South America, especially in Columbia, Ecuador, Peru, and Bolivia. He enumerates 105 species, among which are 24 new species and 17 new varieties. Several of the varieties are figured. H. Christ ‡ gives a brief account of a second collection of ferns gathered in Mexico by G. Munch in Chiapias, the southern-most province of Mexico. Four of them are new and are provided with descriptions. With them is associated the description of a new *Polypodium* collected by C. A. Purpus at Pachuca, Mexico.

Ferns of the Azores.§—H. Christ gives an enumeration of twenty-eight ferns collected in the Azores by B. Carreiro with the view of rendering the fern-flora of those islands more precise. Nineteen species are common to the Azores and Madeira. Eleven species found in Madeira, and six more found in the Canaries, are absent from the Azores. These are of the xerothermic type, and their absence is conclusive as to the different climate prevailing in the Azores. Also five of these species are endemic in Madeira and three in the Canaries, whereas in the Azores only a few varieties and sub-varieties are endemic. An Azorean peculiarity markedly exhibited by some of the species, *Dicksonia culcita*, *Elaphoglossum squamosum*, *Polystichum aculeatum*, *Aspidium paleaceum*, is the thick covering of scales on the stipes—a phenomenon still unexplained. Among the eight cosmopolitan or European ferns of the Azores, four are not found in Madeira. Three introduced species were found: *Gymnogramme calomelanos* from tropical America; *Adiantum hispidulum* from tropical Asia; and a species of *Diplazium*, probably *D. lasiopteris* of the Nilgherries. This plant is described carefully. It has been wrongly referred to *Asplenium crenulatum* by Trelease.

Philippine Ferns.‖—E. B. Copeland gives a list of the ferns and fern allies collected by E. D. Merrill on Mount Halcon in the Philippine island Mindoro. This mountain, having an altitude of nearly 9000 ft., is probably third in height in the Philippines, and has an unusually heavy rainfall. It is notable for the absence of the savannah-wood zone, the weak development of the high forest, the great development of the

* Denkschr. k. Akad. Wiss. Wien, lxxix. (1906) 2 pp. (1 table).
† Hedwigia, xlvi. (1907) pp. 322–64 (6 pls.).
‡ Bull. Herb. Boissier, vii. (1907) pp. 413–16.
§ Bull. Acad. Internat. Géogr. Bot., xvi. (1907) pp. 152–60.
‖ Philippine Journ. of Sci. Manila, ii. (1907) pp. 119–51 (3 pls.).

mossy forest, and the presence above this of a montane brush which degenerates in places to a mere heath composed of a few vascular plants of Australian and north-temperate type. The author supplies some remarks on the geographical distribution of the species in the collection; the fern-flora has migrated from the south, and the Celebes element seems to dominate over the Bornean. He also points out what large areas on the flanks of the mountains, where the fern vegetation reaches its most luxuriant element, remain to be explored. In the systematic list are 184 ferns and 13 fern-allies. Of the former 15 are new species, and 1 of the latter.

Chinese Ferns.*—H. Christ gives an account of the more interesting ferns in a collection of 100 specimens received from F. Ducloux, a missionary in Yunnan. Descriptions of ten new species and two new varieties are supplied. He also describes twelve species and two varieties in some collections made by Pères Esquirol and Cavalerie in the province of Kouy-Tchéou.

North American Ferns.†—A. K. Harrison and other members of a special committee of the New England Botanical Club publish a list of 39 species, representing the fern-flora growing within 25 miles of Boston, a fairly well marked geographical unit. The list is a preliminary one, but is founded on numerous data.

R. C. Benedict ‡ publishes notes on some ferns collected near Orange, New Jersey, principally concerned with *Dryopteris spinulosa* and its varieties, and the question whether the type-form really occurs in the United States. In an old well was found a self-established specimen of the Japanese *Cyrtomium falcatum*.

Cibotium Baranetz and its Sub-species.§—H. Christ, having made a study of the collective species *Cibotium Baranetz* (erroneously spelled "*Barometz*" in consequence of a typographical error—see Kunze Suppl. Schkuhr, i., 63, in note), finds that the recognition of several sub-species is well justified. He gives descriptions of the following:— *C. Baranetz* J. Sm., *C. assamicum* Hook., *C. sumatranum* (a new sub-species), *C. Cumingii* Kunze.

Gleicheniaceæ of North America.‖—L. M. Underwood publishes his eighth article on American ferns, namely, a preliminary review of the North American Gleicheniaceæ. He recognises as valid genera *Platyzoma* R. Br., *Stromatopteris* Mett., *Gleichenia* J. E. Sm., and *Dicranopteris* Bernh., and supplies a table of characters by which they may be separated. The first two genera are monotypic and Australasian. The author insists upon the importance of a close field-study of the larger members of *Dicranopteris*, especially in their respective type localities, since the specimens are difficult to prepare for the herbarium, and some of the type-material in existence is too meagre to afford an intelligible conception of the species. It is of great importance to obtain the primary

* Bull. Acad. Internat. Géogr. Bot., xvi. (1907) pp. 129–52.
† Rhodora, ix. (1907) pp. 81–6. ‡ Torreya, vii. (1907) pp. 136–8.
§ Philippine Journ. of Sci. Manila, ii. (1907) pp. 117–18.
‖ Bull. Torrey Bot. Club, xxxiv. (1907) pp. 243–62 (fig.).

fork in a normal condition, showing the characters of the bud-scales and the extent of the decurrence of the segments on the secondary and primary internodes. Rejecting the massing of the American species due to Hooker and Baker, the author adopts the four sections founded by Diels—*Diplopterygium*, *Holopterygium*, *Acropterygium*, *Heteropterygium*. He supplies a clavis to the eighteen North American species, and proceeds to treat the species individually, describing four of them as new.

Genus Cyathea in the West Indies.*—L. M. Underwood treats of the distribution of the genus *Cyathea* in the West Indies. The common West Indian species, *C. arborea* (1793) is the type of the genus. There are about 200 species nearly equally divided between the tropics of the Old World and the New. About 104 species are nearly equally divided between North and South America. No species are common to the Old World and the New. With two or three exceptions, no species are common to North and South America. Each species is as a rule local in its distribution. *C. arborea* alone is common to the Lesser and all the Greater Antilles. *C. insignis* is common to Cuba and Jamaica; *C. pubescens* to Jamaica and Porto Rico; *C. Tussacii* to Jamaica and Hispaniola; *C. muricata* to Guadeloupe and Martinique; *C. tenera* to Trinidad and the Lesser Antilles. Endemic in single islands are—Cuba 3, Porto Rico 1, Jamaica 9, Dominica 1, St. Vincent 1, Trinidad 2. In Jamaica the endemic species occur only at altitudes above 3000 ft., or even 5000 ft. The higher altitudes of Cuba and Hispaniola need to be explored. The following morphological and physiological features require investigation :—(*a*) Marked structural differences in shape and arrangement of leaf-scars, supposed to be due to differences of nutrition and consequent rapidity of growth. (*b*) The function of certain gland-like structures at the bases of the leaves in certain species, and at the bases of the pinnæ in others. (*c*) The origin of pendent lateral bud-like branches (especially in *Cyathea dissoluta*), organs of vegetative reproduction.

Validity of Polystichum Lonchitis and P. aculeatum.†—P. Lachmann and L. Vidal discuss the specific value of the distinctive characters of *Polystichum Lonchitis* and *P. aculeatum*. After a careful comparison of the two plants, they come to the conclusion that they are specifically distinct: (1) in the amount of division of the frond, which in *P. Lonchitis* is pinnate, but in *P. aculeatum* is bipinnate or bipinnatisect; (2) in the number of vascular bundles passing into the leafstalk at its insertion on the stem—two in *P. Lonchitis*, three or four in *P. aculeatum*; (3) in station and habitat, for *P. Lonchitis* occurs on rocks on high mountains; and *P. aculeatum* in woods in the plains or on the lower mountains; (4) by their degree of polymorphism, insignificant in *P. Lonchitis*, but extremely marked in *P. aculeatum*. They hold also that (5) *P. Plukenetii* is a young or dwarf form of *P. aculeatum*, and should be struck out of systematic lists; and that (6) to unite *P. Lonchitis* and *P. aculeatum* on the strength of intermediate forms would necessitate

* Torreya, vii. (1907) pp. 106–7.
† Bull. Soc. Bot. France, liii. (1906) pp. 103–16 (figs.).

the establishment of a collective species so large as to be inadmissible in the present state of descriptive botany.

Affinity of Neurocallis.* — H. Christ, in a supplementary note corrects an error made in his fifth paper on the ferns of Costa Rica. A new species, *Pteris macrodictya*, was there described from fragments of a sterile frond of what is now shown to be *Neurocallis*. It is interesting that Baker made an analogous mistake in describing a soriferous frond of *Neurocallis* as *Pteris dominicensis*, an error which Jenman set right. The outcome of the present correction is that the distribution of *Neurocallis*, believed hitherto to be confined to the West Indies, is now extended to Central America, and that an addition is made to the species common to the Antilles and Costa Rica. The genus *Neurocallis* is of uncertain affinity. Placed by some writers in *Acrostichum* and doubtfully near *A. aureum*, its irregular network of veins is more like that of the *Pteris Haenkeana* group than the small regular network of *A. aureum*. Its texture is herbaceous, not coriaceous; the sori linear, marginal, leaving free a wide costal band; edge of soriferous pinnæ narrowly reflexed like an indusium. Just as *Stenochlæna* is regarded as a derivative of *Asplenium*, so *Neurocallis* may prove to be an acrostichoid species of *Pteris*. At present it should be left an independent genus.

Dimorphic Fronds of Stenochlæna.† — H. Christ discusses the biological and systematic meaning of dimorphism and malformation in epiphytic ferns, especially *Stenochlæna*. Climbing ferns, which have to grow up to a height of some 170 ft. in order to get the benefit of the sunshine, require the most ingenious contrivances to maintain their existence. Such are the humus-storing nest-leaves of *Drynaria* and *Polypodium biforme*, the sap-storing tubers of the stolons of *Nephrolepis*, the so-called water-leaves of *Asplenium obtusifolium*, leaves of analogous function in *Pteris*, and above all the marvellously multiplex lower leaves of *Stenochlæna*. This latter plant roots in the ground and sends up a branched rope-like climbing stem to a height of 60 or 100 ft. or more, and bears the ordinary assimilatory and soriferous fronds at the top of the tree by which it has climbed. But down below it is clad with a dense foliage of deep green tender finely divided leaves of utterly different appearance—so different in fact that they have been referred by the older authors to other genera, namely to *Scolopendrium* by Bory, to *Davallia* by Hooker, to a special genus *Teratophyllum* by Mettenius, to *Diplora* and *Triphlebium* by Baker. Karsten, though giving us an excellent account of them and a good interpretation of their functions, still held to their inclusion in the pseudogenus *Teratophyllum*. One of the first to claim them as appendages of *Stenochlæna* was Bishop Hose. Copeland's *Asplenium epiphyticum* is without doubt a *Stenochlæna*. Christ describes the manifold variety of form of these lower leaves and points out their more primitive Hymenophyllaceous structure as compared with the upper assimilatory leaves, and holds that their function is to absorb moisture and aid in the nutrition of the plant. There is, he believes, an atavism about them; they are an ancient type of leaf

* Bull. Herb. Boissier, vii. (1907) pp. 585–6.
† Verh. Schweiz. Natur. Ges., St. Gallen, 1906, pp. 178–88 (12 pls.).

retained for functional purposes; and they bear pseudo-sori and pseudo-indusia, which have misled botanists into describing false species; for instance, *Triphlebia dimorphophylla*, *T. Linza*, *T. longifolia*, *Diplora Cadieri*. These pseudo-sori point out the affinity of *Stenochlæna* to *Asplenium*, and especially to *A. multilineatum*, which exhibits a similar multiplicity of leaf-form, a parallelism of metamorphosis. *Stenochlæna* used to form a section of *Acrostichum*, from which other groups must be separated; for instance, *Gymnopteris* or *Leptochilus* must be transferred to the Aspidieæ, as also *Polybotrya* and *Stenosemia*, whilst *Hymenolepis* and *Photinopteris* belong to the Polypodieæ. The author shows that similar appendages occur in two of the long-climbing *Lindsayæ*. In conclusion, he calls attention to the aphlebia in the fossil ferns *Sphenopteris* and *Pecopteris*, and again in the existing ferns *Hemitelia capensis*, *Cyathea Boivini*, and *Trichomanes aphlebioides*. Photographs of the principal forms under discussion are given.

Mutations of Scolopendrium.*—C. Schröter publishes notes on the mutation forms of *Scolopendrium vulgare*, 375 of which have been described by Lowe, 228 having been found in the wild state. O'Kelly in Ireland records 540 variations, 368 of which occurred wild round his house. Though English cultivators claim that spores of a normal part of a frond produce normal plants, and spores of an abnormal part of the same frond produce abnormal plants, yet this assertion has not been proved scientifically. The variations of the frond can be grouped. The author figures them. The variations, through their sudden isolated occurrence and their spore-constancy, bear the character of mutations.

Apospory and Apogamy in Ferns.†—J. B. Farmer and L. Digby publish some studies in apospory and apogamy in ferns, especially the cytological aspects of the problem. Incidentally, the opportunity is taken of correcting the spelling of the words "maiosis" and "maiotic" to "meiosis" and "meiotic," in accordance with their Greek derivation. A detailed account is given of each of the following:—*Lastrea pseudo-mas* vars. *polydactyla* Wills., *polydactyla* Dadds, *cristata apospora* Druery, *Athyrium Filix-fœmina* vars. *clarissima* Jones, *clarissima* Bolton, *unconglomerata* Stansfeld, *Scolopendrium vulgare* var. *crispum Drummondæ*. A brief summary of results follows each study. The succeeding chapter is a general discussion of the results, and contains a suggested classification of the various apogamous and aposporous types. Finally, the authors state their views as to alternation of generations.

Sporophyte of Lycopodium.‡—G. Wigglesworth has been studying young sporophytes of *Lycopodium complanatum* and *L. clavatum*. According to her results, the first root may show a mon-arch, di-arch, and tri-arch arrangement in the same plantlet. The second and following roots show a diarch arrangement. The roots arise endogenously near the apex of the stem, and remain arrested for a time; their branching is apparently dichotomous, one branchlet generally being less vigorous

* Verh. Schweiz. Natur. Ges. Luzern, lxxx. (1906) pp. 321–3 (1 pl.).
† Ann. Bot., xxi. (1907) pp. 161–99 (5 pls.).
‡ Tom. cit. pp. 212–34 (1 pl.).

than the other. In *L. complanatum* a short strand from the main stele passes into the foot, and the peripheral cells of the foot retain the appearance of an absorptive tissue after the disappearance of the prothallus. The arrangement of the vascular tissues at the base of the stem shows much irregularity, but the xylem appears to be continuous with that of the first root. In the lower part of the stem the xylem strands take a very irregular course, fusing and sub-dividing. The upper part of the stem shows a tri- or tetr-arch arrangement of xylem with central metaxylem, generally connected with two or more groups of protoxylem. The apex is occupied by several large actively dividing cells. The stem branches dichotomously, one branch being generally weaker than the other, or by retardation forming a pseudo-adventitious bud in *L. complanatum*. The first leaves are scale-like, unveined, and spirally arranged. The later leaves have a vascular strand of a few narrow tracheids surrounded by thick-walled bast.

Vascular System of Hymenophyllaceæ.*—A. G. Tansley prints the third of his lectures on the evolution of the Filicinean vascular system, noting first the approximate parallelism of development between vascular and sporangial characters in the Leptosporangiate Ferns. Among Bower's Simplices we have almost exclusively protostelic and solenostelic forms; the Gradatæ include the protostelic Hymenophyllaceæ, but are of the most part solenostelic; among the Mixtæ are included the great mass of dictyostelic types. The author then discusses the Hymenophyllaceæ, whose unilamellate fronds, he is inclined to think, have been derived, as in *Todea* and *Asplenium*, from fronds of the normal type with stomata and intercellular spaces. The sori and sporangia are of a relatively primitive type. The vascular system is on the whole simple, and, while the characters of the simplest forms are undoubtedly due to reduction, there is ground for supposing that in the median types occur really primitive features which are shared by the Botryopterideæ. Such a median type is found in *Trichomanes reniforme* and certain species of *Hymenophyllum*. After treating the various types in detail, he concludes that this median type is probably nearly primitive for the Ferns, and is unlikely to be a much reduced form. Moreover, the marked dichotomy in the branching of the Hymenophyllaceous pinnæ may also be considered a primitive feature retained by many members of the family.

Wounds in Calamites.†—M. C. Stopes describes some instances of the formation of callus wood in wounded Calamites preserved in three slides in the fossil collection of the Manchester University Museum. In both cases the wound was so deep as to pass through the vascular cylinder and reach the pith, and the formation of new tissue curved round the open ends of the broken ring and formed a quantity of wood in the pith-cavity in inverse orientation to the normal strands.

American v. European Pteridology.‡—L. M. Underwood demonstrates that *Woodwardia paradoxa*, a fern from British Columbia recently

* New Phytologist, vi. (1907) pp. 109–20 (figs.).
† Ann. Bot., xxi. (1907) pp. 277–80 (1 pl.).
‡ Torreya, vii. (1907) pp. 73–6.

described as new by Wright, is identical with *W. Chamissoi* Brack. (1854) from California, and also with *W. spinulosa* Mart. and Galeotti (1842) from Mexico, both of which in time past have been wrongly referred to *W. radicans*. And he makes this unnecessary creation of a new name the text for a severe homily directed against European pteridologists, especially those of the Hookerian school. He commends the following suggestions to the attention of European fern students: "1. Make a study of geographic distribution in its relation to specific limitations. 2. Consider type locality as a fundamental part of a plant description; it is the lack of this element that makes Christensen's Index just short of the ideal. 3. Beware of any species with a wide range as recorded in Synopsis Filicum or that has any extended synonymy either there or in Species Filicum; there are few species of world-wide distribution, and there will be sure to be something wrong with wholesale slaughter; these are danger marks not to be disregarded. 4. Synonyms and homonyms are still important factors in taxonomy."

VUILLEMIN, P.—**Sur les variations de l'Equisetum palustre L.** (On the variations of *Equisetum palustre* L.)

[From a study of the numerous transitions exhibited by examples of this species, gathered at the same spot on the same day, the author is led to conclude that there is not any absolute difference between Equiseta with uniform shoots and Equiseta with dimorphous fertile and sterile shoots.]

Bull. Soc. Bot. France, liii. (1906) pp. 37–45 (1 fig.).

Bryophyta.

(By A. GEPP.)

Reproduction of Mosses and Ferns.*—J. Burton gives a plain and generalised account of the reproduction of mosses and ferns in the simplest language consistent with accuracy. He defines sexual and non-sexual reproduction, and describes the alternation of generations in detail as occurring in the life-history of the mosses on the one hand and in that of the ferns on the other, indicating the main points of contrast and correspondence. In conclusion, he shows that in each case the result of the fertilisation of the oosphere is a more highly developed structure than that which results from the spore. For even in the mosses the mere cellular tissue of the oophyte has a far lower organisation than the sporophyte with its inner columella surrounded by a ring of spore-producing tissue, outside which is the assimilatory tissue with its air-spaces, the sub-epidermal tissue, and the strongly developed epidermis with its stomata.

Problems of Moss Distribution.†—A. Geheeb discusses the distribution of *Tetraplodon mnioides* in Germany. It is an arctic and alpine moss, seldom occurring in the north German plain. Yet it has recently been recorded as occurring abundantly and fruiting freely at Rheine in Westphalia, though unknown in precisely similar surroundings in the rest of the province. In attempting to explain its occurrence, Geheeb quotes a theory that the spores have been carried by the wind from the

* Journ. Quekett Micr. Club, x. (1907) pp. 1–8.
† Rev. Bryolog., xxxiv. (1907) pp. 76–7.

Harz mountains, and suggests a second hypothesis—that they have been imported from Scandinavia by migratory birds, citing the curious distribution of *Mnium spinulosum*, newly recorded for North Germany, as a parallel instance.

Relations between Moss Structure and Habitat.*—A. J. Grout points out some relations between structure and habitat in mosses. Xerophytic species apparently tend to develop short thick-walled leaf-cells, often with papillæ over the lumen. Presumably the papillæ tend to retard transpiration. Pleurocarpous mosses growing on trees tend to develop short thick-walled cells, especially at the basal angles of the leaves—a similarity of structure which has led to confused classification of such mosses. Tree-growing mosses also tend to develop erect capsules and the correlated imperfect peristomes. This also to some extent seems to apply to other xerophytic mosses. Aquatic or sub-aquatic pleurocarpous mosses apparently tend to develop enlarged and inflated alar cells. Cleistocarpous and gymnostomous mosses appear to exhibit an adaptation to a damp soil not closely covered with other vegetation.

Wrongly Labelled Moss Collections.—A. Geheeb † writes about some mosses collected by Liebetrut in 1864 in Madeira and the Pyrenees, the labels of several of which had become interchanged. For instance, *Fissidens grandifrons* is wrongly labelled as from Madeira, while an unknown *Plagiothecium* from the Pyrenees turns out to be *Crossomitrium fontanum*, and therefore must have come from Madeira. Again, *Polytrichum alpinum* from Madeira is absurd, but would pass if from the Pyrenees. This collection was in the possession of the late G. Bauer (1794–1888) of Berlin.

A. Geheeb ‡ writes about another collection of mosses, apparently collected at Colima in Mexico by E. Kerber and yet containing specimens of *Splachnum luteum* and *S. rubrum* (which are known only from the Arctic regions). This collection reached Geheeb through the hands of G. Egeling, who added to it some South American specimens, gathered by Lechler and labelled by Hohenacker; but among them curiously enough was a fruiting specimen of *Dawsonia superba* which is not a South American but a Polynesian species.

Classification of Mosses.§—V. F. Brotherus has completed another part of his systematic arrangement of the Musci in Engler and Prantl's "Die Natürlichen Pflanzenfamilien." The families treated are Lembophyllaceæ, with four genera, one of which is new—*Dolichomitra*; Entodontaceæ, with nineteen genera, two of which are new—*Schwetschkeopsis*, *Entodontopsis*; Fabroniaceæ, with ten genera; Pilotrichaceæ, with two genera; Nematoceæ, with one genus; Hookeriaceæ, with twenty-six genera, four of which are new—*Bellia*, *Leskeodon*, *Lepidopilidium*, *Callicostellopsis*.

Yorkshire Muscineæ.‖—W. Ingham publishes notes on two Yorkshire hepatics. (1) *Lophozia atlantica* was found by him at Hebden

* Torreya, vii. (1907) pp. 128–9.
† Rev. Bryolog., xxxiv. (1907) pp. 70–1. ‡ Tom. cit., pp. 71–3.
§ Leipzig: W. Engelmann, 1907, lief. 227–8, pp. 865–960.
‖ Naturalist, No. 603 (1907) pp. 151–2.

Bridge in June 1904, growing in large patches on blocks of millstone grit. The plant is about the size of *L. gracilis*, but that species is confined to limestone and bears no stipules. *L. atlantica* had been recorded for Britain only once previously, namely, from Caithness, D. Lillie, 1901; but it now appears to have been found by W. B. Waterfall in Cumberland, so long ago as 1886, and in Clyde Isles by S. M. Macvicar in 1906. It is also found in Norway and the Faröe Isles. (2) The author also points out the characters which are most useful for distinguishing *L. badensis* Schiffn. (*Jungermannia acuta* a Lindenb.; *J. luridula* Wils.) from *L. turbinata* Steph., with which it has been much confused. He appends its distribution—namely, Scandinavia, Scotland (4 stations), England (4 stations in Yorkshire and 1 in Sussex).

C. A. Cheetham * contributes brief notes on two Yorkshire mosses, namely *Leskea catenulata* and *Orthothecium rufescens*, which have been omitted in recent lists.

Muscineæ of North Devon.†—C. E. Larter publishes lists of 181 species of mosses and 62 hepatics gathered by himself, C. A. Briggs, W. Mitten (in 1875), and others, in the botanical districts of Braunton and Sherwill in North Devon. Among them is *Lophocolea alata* Mitt., a new species collected at Lynmouth by W. Mitten in 1875: it is described and figured. Notes on the earliest British records of *Dumortiera irrigua* are given, Taylor having discovered the plant in Ireland in 1820, and Wilson in 1829, and Ralfs in North Devon at Combemartin in 1842. *Fissidens Mittenii* Tindall was found near Barnstaple by Mitten in July 1875, and has never been gathered again. The author has been aided in his work by Mitten, Dixon, and Macvicar.

Moss-flora of Hamburg.‡—G. R. Pieper and R. Timm give some new results arising from a study of the Hamburg flora. These consist of records of 21 hepatics, 4 sphagna, 36 mosses, with some notes on the localities.

European Sphagna.§—C. Warnstorf gives a conspectus of the sphagna collected by Max Fleischer in different regions of Europe, namely, in Norway, Switzerland, and France. Critical notes are appended to the following: *S. crassicladum*, *S. rufescens*, *S. Pylaiei* var. *sedoides*, all of which were gathered in Brittany.

Swiss Mosses.‖—H. N. Dixon publishes notes on the more interesting mosses collected by him in the Bernese Oberland, in the neighbourhood of Adelboden and on the Gemmi Pass. In the Alps the best hunting-grounds for mosses are in the sub-alpine woodland and near the the snow-line. The pastures and pinewoods of the intermediate zone are less productive. The northern approach to the Gemmi Pass is almost glacial in its surroundings and in its flora; but there is a sudden transition in the moss-flora as the sheltered southern Valaisian zigzags of the pass are descended, high alpine species being abruptly replaced by sub-alpine and even meridional types. At an altitude of 6500–7500 ft.

* Naturalist, No. 604 (1907) p. 190.
† Rep. Trans. Devon. Assoc., xxxviii. (1906) pp. 270–86 (fig.).
‡ Allg. Bot. Zeitschr., xiii. (1907) pp. 46–8, 63–4.
§ Tom. cit., pp. 61–3. ‖ Rev. Bryolog., xxxiv. (1907) pp. 57–64.

the author found fruiting specimens of *Tortula inermis*, a Mediterranean species; *Barbula unguiculata* and *B. gracilis*, rarely seen so high up; *T. ruralis*, usually distinctive of lowland regions; *Eucalypta vulgaris*, seldom reaching 6000 ft. in the central Alps. Notes on 34 species are added. A. Martin * contributes a list of 49 mosses and 15 hepatics collected in the valleys of Guttanen, Hasli, Grindelwald, Lauterbrunnen, and Glütsch.

French Muscineæ.†—Ch. Douin publishes an enumeration of the mosses and hepatics of the department of Eure-et-Loir, containing some 300 mosses, 16 sphagna, and 86 hepatics. The hepatics had never been studied before. The author obtained the help of the leading experts in Europe for the confirmation of his results. The plants are arranged according to the systems of Limpricht, Warnstorf, and Boulay. The author gives an account of the botanists, literature, and exsiccati that have had any bearing on the work; and of the geology and physical geography of the department. Three new species of *Cephaloziella* and one of *Didymodon* are described as new. Numerous critical notes are inserted in the text. G. Desmier ‡ reprints lists amounting to 106 mosses and 24 hepatics, being the total recorded for the French department, Charente-Inférieure, previous to September 1905, when he, during a visit of two days at Montendre, made a collection which added 30 mosses, 7 sphagna, and 6 hepatics to the moss-flora of the department. Whereas the previous collections were made on calcareous soil, Desmier's additions were obtained from siliceous soil. The same author § collected in the neighbourhood of Melisey and Servance, in the department of Haute-Saône, in May and June 1906, and publishes some notes on the rarer mosses gathered. The most interesting species is the very rare *Bruchia vogesiaca*, found on the muddy shore of a pond near Servance, where it was abundant, but had disappeared by the end of September. Originally discovered on the Hohneck (Vosges) in 1822, *B. vogesiaca* has since been recorded from near Gabarret (Landes) and Saint-Sylvestre (Haute-Vienne); also from one station in the Palatinate (Germany), and one in Tyrol. Desmier also collected the northern *Sphagnum Dusenii* and *Sporledera palustris*, upon which latter he cites some critical remarks by Boulay.

Hungarian Mosses.—I. Györffy ‖ publishes some further contributions to the moss-flora of the Hohe Tatra, with critical notes upon the following species—*Pottia minutula*, *Didymodon giganteus*, *Amphidium lapponicum*, *Amblystegium Sprucei*. The second and third of these are treated in considerable detail as regards their morphology and ecology. The same author ¶ records the occurrence of *Dicranum fulvum* and eight other mosses at Bade Stoósz, where they were collected by M. Futó. He also gives a fresh description of *Rhacomitrium canescens* var. *epilosum* H. Muell., which has been found in plenty on Tertiary sandstone at

* Rev. Bryolog., xxxiv. (1907) pp. 64–7.
† Mém. Soc. Sci. Nat. Math. Cherbourg, xxxv. (1905–6) pp. 221–358 (figs.).
‡ Bull. Soc. Bot. France, liii. (1906) pp. 338–43.
§ Tom. cit., pp. 537–40.
‖ Magyar Bot. Lapok, vi. (1907) pp. 34–47 (2 pls.).
¶ Tom. cit., pp. 178–80.

2000 ft. under the Zipser Magura, though recorded for Hungary previously only from granite at a height of 5000 ft. on the Hohe Tatra. I. Györffy * shows that *Polytrichum ohioense* Ren. and Card. and *P. decipiens* Limpr. are not identical, but differ in the form of the marginal cells of the lamellæ and in the constitution of the leaf-nerve. The former species is confined to the New World, and the latter to the Old. He also gives details as to the anatomy of the sexual and asexual generations of *Pterygonerum cavifolium*. M. Péterfi † gives an account of *Grimmia plagiopodia*, its morphology and distribution, and its distinguishing characters. He also treats of the Hungarian species of *Cephaloziella*; the discovery of *C. byssacea* in Hungary, and its morphology; the distinctive characters of *C. divaricata*; and the occurrence of *C. Jackii* in Hungary. He also discusses the morphology of *Oligotrichum incurvum*, disagreeing with Limpricht's interpretation of its vascular bundle, and demonstrates that it is not homogeneous, but contains a hadrome for the conduction of water, and a leptome for the conduction of plastic material. He also deals with the ecology of peat-mosses, their origin and development, the physiological and anatomical characteristics of the sphagna, and mentions certain ecological properties according to which he distinguishes hydrophilous and xerophilous forms, and gives a synopsis of 31 species and their forms, classified according to these properties. G. Prodán ‡ records new localities in Hungary for three cleistocarpous mosses—*Acaulon muticum*, *A. triquetrum*, and *Phascum cuspidatum*.

North American Mosses.—A. J. Grout § publishes some notes on R. H. True's experiments directed towards the investigation of the exciting causes of the curvature of the seta in *Funaria hygrometrica* and *Mnium cuspidatum*. The young sporophyte grows erect, being negatively geotropic; but the young capsule becomes positively geotropic and assumes a pendent position. Illumination determines the plane in which the young capsule bends over. Incidentally, he shows that the entire zone of growth of the young sporophyte lies entirely within the shelter of the calyptra, and is thus protected from desiccation. I. Thériot ‖ gives a description and figures of *Grimmia Dupreti*, a new species collected near Montreal by H. Dupret. E. J. Hill ¶ publishes critical notes upon the validity of some North American species of *Fissidens*: *F. inconstans* Schimp., *F. synoicus* Sulliv., *F. minutulus* Sulliv., *F. exiguus* Sulliv. He re-describes the first two species, and contrasts all four with their respective affinities. E. M. Dunham ** records the occurrence of a curious variety of *Polytrichum gracile* in a wooded swamp in Maine. The leaf-margins are three times wider than in the type, and the lamellæ are three cells high instead of four or five. A. L. Crocket †† announces the discovery of *Catharinæa crispa* in Maine, where it had never previously been recorded. It was fertile, and was found in a pasture on knolls where some six years ago a growth of alders

* Növényt. Közlem., v. (1906) pp. 86–92, 135–45.
† Tom. cit., pp. 46–51, 92–7, 124–35.
‡ Op. cit. (1907) pp. 25–6.
§ Bryologist, x. (1907) pp. 60–1.
‖ Tom. cit., pp. 62–5 (1 pl.).
¶ Tom. cit., pp. 67–74.
** Rhodora, ix. (1907) p. 64. See also Bryologist, x. (1907) p. 75.
†† Tom. cit., p. 74. See also Bryologist, x. (1907) p. 74.

had been cleared away. E. B. Chamberlain,* having received specimens of an unknown *Catharinæa* from Maine, has ascertained that it is identical with *C. Macmillani* of Holzinger, whose description he republishes, with new figures and new records of the plant's distribution. It occurs in Minnesota, Missouri, Connecticut, New Jersey, Maine.

Mexican Mosses.†—A. Geheeb gives an account of the vicissitudes that have attended the determination of a century of mosses collected by Sartorius in Vera Cruz, Mexico, in 1880, 1883, 1884. Among them is *Rhodobryum Levieri*, a new species; and two American species are recorded for Mexico for the first time.

Hypnum riparium L. in New Zealand.‡—H. N. Dixon recapitulates the evidence against the occurrence of this species in New Zealand; but is able to record the indisputable existence of an aquatic form of the species near Hunterville, north of Marton, in the North Island, where it was found by C. J. Burgess in 1905. It was also gathered by J. Drummond on the Swan River, West Australia.

Fissidens algarvicus Solms as a British Moss.§—H. N. Dixon records the discovery of this moss in England, collected by G. B. Savery on red sandy shale near Exeter in the early spring of this year. Various authors have referred *F. algarvicus* to *F. incurvus*, *F. pusillus*, *F. viridulus*, etc., as a variety. But Dixon shows that it is distinct from these species and also from *F. intralimbatus*; that it exhibits more similarity to *F. Orrii*—an immigrant of the Glasnevin garden—but is distinguished by certain leaf-characters; and finally that it is identical with *F. sordagnai*, so far as can be judged from Venturi's description of that species, save in the one character of the sculpturing of the spores.

Distribution of Fissidens grandifrons.‖—A. Geheeb reports having found in a collection of mosses collected by W. Schimper in Abyssinia a specimen of *Fissidens grandifrons*, for which the only African locality previously recorded was Algeria. The collection was received from Stephani, and was probably one of the sets issued by Hohenacker.

Philonotis adpressa Ferg., a False Species.¶—G. Desmier discusses the history of *Philonotis adpressa* Ferg., which has been shown by Loeske to be, not a specific type, but a series of forms artificially united under a common superficial character, and belonging, some to *P. fontana*, some to *P. seriata*. The author describes the special characters which these forms have in common; and calls attention to a particular specimen gathered in Haute-Vienne by Lachenaud, over which experts have disputed, and which he himself is convinced must be referred to *P. cæspitosa*. Accordingly he names it var. *adpressa* of this species. It is a confirmation of Loeske's theory as to the parallel forms observable in the different hygrophilous species of *Philonotis*.

Bryum and its Species.**—C. Meylan, in describing a new species of *Bryum*, *B. Colombi*, gathered on the Simplon, and of near affinity to

* Rhodora, ix. (1907) pp. 98–100 (1 pl.).
† Rev. Bryolog., xxxiv. (1907) pp. 74–5.
‡ Journ. of Bot., xlv. (1907) p. 281.
§ Tom. cit., pp. 237-40.
‖ Rev. Bryolog., xxxiv. (1907) p. 78.
¶ Tom. cit., pp. 68–9.
** Bull. Herb. Boissier, vii. (1907) pp. 591–2.

B. subglobosum and to *B. pallescens*, speaks of the hesitation which has prevented him for some years from adding to the already perplexingly numerous species in that genus, and of the long study which he has bestowed upon such variable species as *B. pendulum*, *B. arcticum*, *B. inclinatum*, and *B. pallescens*. A certain number of European *Brya* have never been found but once. It is absurd to suppose that they were old species now extinct, or new species in process of formation. They must have been accidental forms which have failed to establish themselves. If they had survived, their characters might have become fixed. What we want in a genus so prolific in varieties and forms is to test the coefficient of constancy of the characters of these forms, in order to determine how far this constancy avails as a basis for the creation of new species.

Rearrangement of Drepanocladus and its Allies.*—L. Loeske, in showing that *Drepanocladus* is a biological conglomerate of genera, takes the view that, though in the mosses as a whole there is no substitute for the sporogonium as a basis upon which to found a classificatory system, the variation of form manifested by the acrocarpous sporogonium being of great importance, yet in the Hypneæ at least a limit must be set to the value attached to the sporogonium as a generic character. Loeske holds that the ancestors of the Hypneæ had already developed their sporogonium almost to its fullest capacity at a time when the vegetative part of the plant was first entering upon the period of its most active development; hence the descendants, though they have developed great morphological differences in their vegetative organs, retain practically the same sporogonium. He maintains that plants which have a similar sporogonium do not therefore necessarily belong to one and the same genus. Having devoted months of study to every available species and form, he has at last come to definite conclusions—inter alia, that *Drepanocladus* is a biological mixture of genera. He discusses such characters as the single or double nerve, the serrated margin, the uncinate leaves, etc. He recognises three well-marked new genera: *Sanionia*, *Limprichtia*, *Warnstorfia*, which take equal rank with *Drepanocladus* (reformed), *Pseudocalliergon* (new genus) and *Scorpidium*. 1. *Sanionia* (named after Sanio) includes *Hypnum fertile*, *H. uncinatum* with all its forms. 2. *Limprichtia* includes *H. vernicosum*, *H. intermedium* (with *H. Cossoni*), and *H. revolvens*. 3. *Warnstorfia* includes *Hypnum exannulatus*, *H. fluitans*, *H. purpurascens*, *H. tundræ*, etc. 4. *Drepanocladus* retains the *Kneiffii* and *Sendtneri* groups. 5. *Pseudocalliergon* includes the orthophyllous species *H. turgescens*, *H. trifarium*, and *H. longicuspis*. 6. *Scorpidium* contains *H. scorpioides*. The first three of these genera he places in the new group *Drepanopsis* allied to the Stereodonteæ; and genera (4) to (6) he puts into group *Drepanocladus* allied to *Amblystegium*. Leaving this subject, the author gives a series of notes on various subjects; for instance, since publishing a recent paper on the relationships of the European Brachythecieæ, he has discovered a connecting link for *Camptothecium* with *Brachythecium* through the *B. salebrosum* group. Again, he holds that *Thuidium*, *Cratoneuron* and *Amblystegium* are very closely allied; and that *Cratoneuron* and *Hygroamblystegium* have probably arisen from a

* Hedwigia, xlvi. (1907) pp. 300–21.

common centre. He differs from Limpricht by taking the view that *Amblystegium filicinum* and *A. curvicaule* belong to *Hygroamblystegium*; and he holds that *H. fallax* and its allies form a strongly differentiated aquatic branch of this genus. He strongly suspects the accuracy of Renauld's contention that *Hypnum filicinum* is converted into "*H. fallax* (*Vallis Clausæ*)" in a swift stream in the Pyrenees. Parallel forms they perhaps may be, but not a true conversion from the one species to the other. He also discusses at some length the value of species, sub-species, genus and "gesamtgattung," and expresses his own views on the subject, and points out the influence of the personal factor in defining the limits of a species. He maintains that everything should be described without exception, but that only those forms should be named which are capable of being recognised with certainty from a description or plate, or of which the author has a sufficient stock of material to supply samples to everyone interested.

European Hepaticæ.*—K. Müller, of Bromberg, publishes the fourth part of his monograph of the European hepatics. He finishes the Riociaceæ, giving descriptions of 14 more species of *Riccia* and one each of *Ricciocarpus* and *Tessellina*. Proceeding to consider the Marchantiaceæ, he shows in a diagram the probable course of descent of the genera. In contrast to the Riccieæ, the Marchantiaceæ exhibit great variety in the anatomy of the thallus and the composition of the two sorts of inflorescences, thus affording far more characters for systematic determination. And the author gives a useful list of points to be noted in the examination of unknown specimens. He appends an artificial key to the genera, based on easily observed and permanent characters, such as structure of thallus, form of stoma, ventral scales, etc. Another key is strictly systematic, and shows the principles upon which the genera are grouped. The species of the following are described—*Corsinia*, *Targionia*, *Cyathodium*, *Clevea* (2), *Sauteria*, *Peltolepis*, *Plagiochasma* (2), *Reboulia*.

New British Hepaticæ.†—S. M. Macvicar publishes some critical notes on the following British hepatics:—*Lophozia Baueriania* Schiffn., *Lophocolea alata* Mitt., *Scapania obliqua* Schiffn., *Modotheca rivularis* Nees. He agrees with Schiffner and Arnell in regarding *Lophozia Baueriana* as a true species, and he points out the most useful characters for distinguishing it from *L. lycopodioides* and *L. Floerkii*; and he sketches out the distribution of these three species in Britain. As to *Lophocolea alata*, published by Larter after Mitten's death, and founded on a single small specimen, Macvicar has examined several additional specimens from the original locality in North Devon and elsewhere, and finds that they vary so much in the specific characters emphasised by Mitten, that it seems better to regard the plant as a sub-species of *L. cuspidata*, which is not so common in England but more common in Scotland. He also records the occurrence of *Scapania obliqua* in this country, shows how it is distinguished from *S. undulata* and *S. uliginosa*, and gives its British distribution. Finally, he gives notes on two varieties of *Madotheca rivularis* which are new to Britain.

* Rabenhorst's Kryptogamen-Flora, vi. lief. 4 (1907) pp. 193–256 (figs.).
† Journ. of Bot., xlv. (1907) pp. 258–63

North American Hepaticæ.*—A. W. Evans publishes some notes on New England hepaticæ. Three of the species treated have a nomenclatorial interest, especially *Nardia geoscyphus*, which has a large synonymy, including *N. hæmatosticta* Lindb. The other species noted are additions to the flora of the New England states, namely, two species of *Lophozia*, five species of *Calypogeia*, one of which is new to science, a new *Scapania*, and the British species *Frullania Tamarisci*, to distinguish which from *F. Asa-grayana* is becoming increasingly difficult. New descriptions and plentiful critical notes are added where necessary.

Dichiton gallicum.†—Ch. Douin gives a minutely detailed description of *Dichiton gallicum*, a new species found by him in the forest of Dangeau (Eure-et-Loir). It is an unexpected addition of a second species to a rare and anomalous genus discovered in Algeria 60 years ago, and five years ago found on the Mediterranean coast of France. The author carefully compares the new species with the original species, *Dichiton perpusillum*, or *D. calyculatum*, and points out the generic resemblances and the specific differences. He discusses the proper place for the genus in a natural classification, giving the views of other writers, but without satisfaction, for he feels that it has no affinity with *Anastrepta* and *Acrobolbus*, and that, if it approaches *Lophozia*, it is allied, not to the section *Sphenolobus*, but to *Bidentes*. The fact is, that *Dichiton*, by its manifold resemblances, is not easy to class in a linear series. C. Massalongo,‡ in a subsequent article, also discusses the same genus, *Dichiton*, partly from a critical point of view, partly in relation to its occurrence in Italy. Adopting *D. calyculatum* as the correct name for the type, and lowering *D. gallicum* to varietal rank, he shows that to the variety must be referred a specimen from Firenze (leg. Levier, 1885), which he published as *Cepholozia integerrima* Lindb., and that to the type must be referred two specimens from Elba (leg. Sommier, 1901, 1904), and two from Sicily (leg. Zodda, 1905–6), which have also been wrongly named *C. integerrima* Lindb. This correction he makes after a study of Lindberg's type. Thus *D. calyculatum* has now been recorded for Algeria, South France, Dalmatia, and Italy. He, just as Douin has done, discusses the connate perichætial bracts of *D. calyculatum* and the analogous formation in *Cephaloziella piriflora* (= *C. Bryhnii*), where he finds it to be a variable character.

Cephaloziella patula Schiffn. in Britain.§—W. E. Nicholson narrates how he gathered in Crete, in the spring of 1906, an hepatic identified for him as *C. Baumgartneri* by Schiffner, who has subsequently shown it to be synonymous with *C. patula*, described under *Cephalozia* by Stephani in 1905. Nicholson has gathered the same species on chalk blocks near his own home at Lewes, in England. He contrasts the plant with its close ally, *C. integerrima* Warnst., a recent addition to the British flora, showing the differences of habit, habitat, and distribution, and giving the names of the bryophytes with which *C. patula* is associated in its growth.

* Rhodora, ix. (1907) pp. 56–60, 65–73 (1 pl.).
† Bull. Soc. Bot. France, liii. (1906) pp. 461–79 (figs.).
‡ Malpighia, xx. (1906) pp. 456–62.
§ Journ. of Bot., xlv. (1907) pp. 279–80.

Cephalozia elachista.*—P. Culmann has carefully re-examined a specimen from Marais de Lossy near Geneva, in Herb. Bernet, which had been named *Cephalozia elachista* by Bernet, but was renamed *C. lunulifolia* by Ch. Meylan last year. Culmann's suspicion that Bernet was right and Meylan wrong was well founded, for the specimen contains a small quantity of the true *C. elachista*, which therefore is, as Bernet stated, a member of the French flora. Also mixed with this species there is a considerable quantity of another species of *Cephalozia*, probably the plant which Meylan referred to *C. lunulifolia*. It belongs, however, rather to *C. connivens*, according to Culmann, because of the large leaf-cells, dentate ciliate calyx, and quadrilobed bracts; but unless the inflorescence can be proved to be monoicous, the determination is not absolutely sure.

Development of Sporogonium of Notothylas.†—W. H. Lang publishes the results of a study of the sporogonium of *Notothylas*, undertaken with a view to clearing away some of the discrepancies between the investigations of Leitgeb and those of later workers, especially concerning the degree of development attained by the columella. The material examined was collected at Singapore by the author, and is referred to *N. Breutelii*. He finds that the embryogeny conforms to the usual type for the Anthocerotaceæ, but that the endothecium, instead of being devoted to the formation of a sterile columella, forms sporogenous tissue for the greater part of the intercalary growth of the sporogonium; in a considerable proportion of cases, however, it produces sterile tissue towards the close of development. The potentially sporogenous nature of the endothecium in this form of *N. Breutelii* leads to various speculations. For instance, the sterile columella in other Anthocerotaceæ was originally the spore-producing tissue, and the amphithecial archesporium is of secondary origin.

ANONYMOUS—**Moss Exchange Club. Report for the Year 1907.**
[The 12th annual report, mainly occupied with an enumeration of the exchange-specimens, with critical notes.]
York: Coultas and Volans, 1907, pp. 233–66.

CAMUS, F.—**Muscinées récoltées en Algérie pendant la session de la Société botanique de France.** (Muscineæ collected in Algeria during the meeting of the Botanical Society of France.)
[Lists of mosses; 19 collected at Oran by Pinoy, 10 at Tlemcen by Pinoy and Klinksieck, and 6 at Beni-Ounif and Ben-Zireg by Pinoy.]
Bull. Soc. Bot. France, liii. (1907) pp. ccxvi.–ccxvii.

CORBIÈRE, L.—**Notice nécrologique sur Auguste-François Le Jolis.** (Obituary of A. F. Le Jolis.)
[Reprint of two funeral orations, and lists of societies with which he was connected, of honours he received, and of papers which he published. He was born in 1823, and died in 1904. His portrait is appended.]
Mém. Soc. Sci. Nat. Math. Cherbourg, xxxv. (1905–6) pp. i.–xx. (1 pl.).

CORNET, A.—**Le Scapania aspera H. Bern. en Belgique.**
[Records the occurrence of *S. aspera* in Belgium, and gives its distribution in Europe.] *Bull. Soc. Roy. Bot. Belgique*, xliii. (1906) pp. 229–30.

* Bull. Herb. Boissier, vii. (1907) pp. 411–12.
† Ann. of Bot., xxi. (1907) pp. 201–10 (1 pl.).

GEHEEB, A.—**Neue Formen und Varietäten von Laubmoosen aus der europäischen Flora.** (New forms and varieties of mosses of the European flora.)
[Critical notes upon ten forms from various localities.]
Beih. Bot. Centralbl. xxii. 2 (1907) pp. 97–101.

MARCHAL, E.—**Arthur Mansion.**
[Obituary notice of A. Mansion (born 1863, died 1905), the leading bryologist of Belgium.] *Bull. Soc. Roy. Bot. Belgique,* xliii. (1906) pp. 376–9.

MÖLLER, H.—**Ett par upplysningar angående den snart utkommande förteckningen öfver Skandinaviens Mossor.** (A few explanations concerning the catalogue of Scandinavian mosses soon to be issued.)
[A list of new name-combinations, with synonyms.]
Bot. Notiser, 1907, pp. 141–5.

RÖLL, J.—**Ueber die neuesten Torfmoosforschungen.** (On the latest researches upon the Sphagna.)
[Conclusion of article.] *Oesterr. Bot. Zeitschr.,* lvii. (1907) pp. 142–6.

STEPHANI, F.—**Species Hepaticarum.** (Species of Hepatics.)
[Continuation of descriptions of new and little known species of *Lophocolea* (27) and *Harpanthus* (1)]. *Bull. Herb. Boissier,* vii. (1907) pp. 477–92.

WARNSTORF, C.—**Riccia bavarica sp.n.**
[Description and figure of a new *Riccia*, collected near Regensburg by I. Familler.] *Hedwigia,* xlvi. (1907) p. 299 (fig.).

Thallophyta.

Algæ.

(By MRS. E. S. GEPP.)

Algological Notes.*—A. Scherffel communicates four short notes on the subjects which have arisen during his studies on the microscopical organisms of fresh-water. The first is entitled variety of development in the stigma of *Pandorina morum* Bory. The author has observed a colony of this alga in which the cells at one pole of the colony possessed markedly large stigmas, while the cells at the opposite pole of the colony had none at all. The cells between the two poles had a stigma of small size. Hitherto this phenomenon has only been observed in *Volvox.* The second note describes swarm-cells with several stigmas, an occurrence which has never yet been described, though Kuckuck had previously observed it in swarm-cells of Phæophyceæ. The present author records the phenomenon in a zoospore of *Bulbochæte,* which had four stigmas, and in a cell of *Chlamydomonas* sp. which had two. Details of both cases are given. The next note is on a forgotten ("verschollene") species of Chlamydomonadineæ, *Carteria dubia* (Perty) Scherffel, of which a description is given, together with a discussion on its systematic position. Finally a new species, *Chamæsiphon hyalinus,* is described.

Fresh-water Algal Flora of the Tropics.†—F. E. Fritsch publishes a phytogeographical and ecological study of the sub-aerial and fresh-water algal flora of the tropics, based on the records contained in the literature enumerated at the end of his paper—a bibliography of 111 titles—and partly upon his own observations made in Ceylon. His object was to make an analysis of the existing data of these tropical

* Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 228–32 (figs.).
† Ann. of Bot., xxi. (1907) pp. 235–75.

regions, and to show that the apparent similarity of algal growth all over the world is less than is generally supposed. His results form an epitome of our present knowledge of the distribution of these forms in the tropics. The subjects treated are as follows: the systematic composition of the sub-aerial algal flora of the tropics; of the submerged aquatic algal flora, of the green algal element in the fresh waters of the tropics (Cladophoraceæ, Siphoneæ, Confervales, Ulotrichales, Zygnemaceæ, Desmideæ, Œdogoniaceæ); of the fresh-water Florideæ. The principal conclusions arrived at are as follows: That in the damp tropics there is always an extensive sub-aerial algal covering. In Ceylon this growth consists almost entirely of Cyanophyceæ, which probably are equally predominant in the other tropics, being essentially a tropical group and the descendants of primitive algal forms. The subaerial green algæ are poorly represented except in case of *Trentepohlia*. In the submerged algal flora and plankton, the Cyanophyceæ form an important but not a preponderant element. In the submerged flora the narrow filamentous forms are much more abundant than the broad, a fact connected with the small amount of dissolved oxygen in the water. *Cladophora* and *Rhizoclonium* are poorly represented, while *Pithophora* is more abundant. *Vaucheria* and *Botrydium* are very rare. The Confervales, except *Ophiocytium*, are not well represented, nor are the Ulotrichales. *Spirogyra* and *Œdogonium* are abundant. The Desmideæ exhibit a marked filamentous tendency. Fresh-water Florideæ appear to be not at all uncommon.

Sub-aerial and Fresh-water Algal Flora of Ceylon.*—F. E. Fritsch publishes the results of some observations made by him on the tropical algal flora of Ceylon, from an ecological and biological point of view. He indicates some of the more important differences between the sub-aerial and fresh-water algal vegetation occurring in the tropics and that found in temperate regions, and he points out the essential variations in tropical vegetation under the influence of diverse external conditions. The author presents his facts under the following headings:

A. Sub-aerial algæ, i.e. those growing on trees, stones, walls, etc. 1. The lowland vegetation. 2. The upland vegetation.

B. Algal vegetation of the inland fresh-waters. 1. Algæ of the tanks and other large inland masses of fresh-water. 2. Algæ of roadside ditches and pools in the lowlands. 3. Algæ of marshes and padi-fields. 4. Algæ of rock-pools. 5. Algæ of wells and springs. 6. Algæ of the small pools of the uplands.

The sub-aerial algæ of the tropics nearly all belong to the Cyanophyceæ, which group plays a far more important part in the tropics than they do with us. They require plenty of moisture and a fairly high temperature, both of which they obtain in the tropics, and on account of their strongly developed mucilage investments they are able to withstand the alteration of wet and dry periods which prevail. As regards the algæ of the tanks in Ceylon, it is found that there also the blue-green element very frequently dominates the entire algal growth. Two new species of Desmids are described, growing in pools.

* Proc. Roy. Soc., Series B, lxxix. (1907) pp. 197-254 (figs.).

Fresh-water Algæ of Schleswig-Holstein.*—W. Heering publishes the first part of a flora of the fresh-water algæ of Schleswig-Holstein and the neighbouring towns of Hamburg and Lübeck, and of the principality of Lübeck. Keys to the species of each genus are given, and diagnoses of the species are appended to each record. Professor Hornfeld has worked out the Desmids. This, the first part of the book, contains the introduction, in which the author gives the history of his collections and studies for seven years in all parts of the province; an account of previous work; examination and preservation of the material; systematic treatment of fresh-water algæ in general and that adopted in this flora; measurements; and general literature. Then the author passes to a treatment of the Heterokontæ. Future parts of the work will deal with Chlorophyceæ, Conjugatæ, Phæophyceæ, Rhodophyceæ, Cyanophyceæ, and Bacillariaceæ. The Characeæ and Flagellatæ will not be included.

Algæ of Brandenburg.†—E. Lemmermann describes *Gonyaulax palustris*, a new species of fresh-water Peridinieæ. He also enumerates all the species of *Gonyaulax*, giving the synonyms, distribution, and references to literature; and appends a key for their determination. Two of the 17 species occur in fresh-water, 4 in brackish-water, and most of them in the warmer seas, 2 only being being decidedly northern forms. The most widely distributed species is *G. polygramma*.

Algæ of the Danube at Vienna.‡—J. Brunnthaler gives the results of his examination of the algæ and Schizophyceæ collected in the waters of the "Old Danube" near Vienna, and divides his remarks into two sections, a general and a special part. In the first section he deals with the biological conditions of the water, giving a map of the district which shows the present river bed and the adjacent stretch of the so-called "Old Danube." He discusses the temperature, transparency and colour of the water, and mentions the phanerogamic plants growing there. This is followed by an account of the plankton, presented also in the form of tables; and critical notes are given of some of the species which constitute the phytoplankton, notably *Ceratium hirundinella*. Twenty-one figures show seasonal variations which occur in this species. The flora of the river bank (benthos) is described, and a table shows the periodicity of certain groups. In the second or special part of the paper, all the algæ found are enumerated in systematic order.

Algæ of the Prague Water Supply.§—F. Ruttner has carefully examined microscopically the water-supply of Prague, which contains a large percentage of organic matter. He gives a brief résumé of investigations of the supplies of other towns, and of his methods employed for catching the organisms. He employed a filter of white tanned goat-leather, after eliminating the coarser organisms with a straining of the finest miller's silk. The proportion of organisms to a given volume of water was estimated by careful counting under the Microscope. The

* Jahrb. Hamburg Wiss. Anst., xxiii. (1905); Beih. 3 (Hamburg, 1906) pp. 59–150. † Beih. Bot. Centralbl., xxi. 2 (1907) pp. 296–300 (figs.).
‡ Verh. k.k. Zool. Bot. Wien, lvii. (1907) pp. 170–223.
§ Archiv Nat. Land. Böhm., Prag, xiii. (1906) 47 pp. See also Bot. Zeit., lxv. 2 (1907) p. 227.

supply is pumped up straight from the Moldau into reservoirs, whence it flows to the houses. Two classes of organisms were found: (1) developed in the water-pipes; (2) derived from the Moldau, the flora of which is known. The first includes such forms as *Leptothrix*, *Crenothrix*, *Cladothrix*, *Clonothrix*, etc. The second includes principally plankton, namely, 10 Flagellatæ, 5 Peridineæ, 16 Diatomaceæ, 34 Chlorophyceæ with Conjugatæ, and 4 Schizophyceæ. Physiological observations are made upon some of these. As regards the periodicity of the species, the author points out that some of them, such as *Synedra Ulna*, predominate in the spring, and others in the autumn, for instance, *Melosira granulata*; but most of them are summer forms, and in winter there is a dearth of both species and individuals. And this periodicity corresponds with that of the Moldau above Prague. The bacteria (*Bacterium coli* and others) are more abundant in winter than in summer. A new water supply is projected.

Phytoplankton of the Traun-see.*—K. von Keissler has examined the phytoplankton of this lake, situated in Upper Austria, and found the total amount of plankton here to be very small, just as in the Hallstätter-see. As regards quality, it is poor in species, at times consisting of one species only, *Asterionella*. The neighbouring larger lakes are much richer in species. The poverty of quality and quantity in the Traun-see may be due to the relatively low temperature of the water even in summer. The Flagellatæ are almost entirely absent; the Peridineæ and Chlorophyceæ are represented by one species each; and the principal constituent is formed by the Diatomaceæ. The results are presented in the form of tables, followed by a list of species.

Algæ of the Kossogol Basin.†—C. H. Ostenfeld reports on the phytoplankton and other algæ of the Kossogol Lake in North-West Mongolia, and of the ponds and rivers in the immediate neighbourhood, collected by Elpatiewsky. The collection consisted of 50 samples of plankton and some of mud. The author's principal object was to study the composition of the phytoplankton, and secondarily to determine the other algæ; and he does not profess that the present list is at all exhaustive, especially as regards the Desmidiaceæ, which in any case are not well represented. His results are divided into two main divisions: (1) a systematic enumeration of the 90 species observed, with habitat, and critical notes; (2) considerations concerning the phytoplankton of Kossogol and the surrounding waters, together with comparisons with each other and with other regions. These are followed by a review of all literature dealing with the algæ of this part of Asia as well as remarks on the geographical and hydrographical conditions of Kossogol; and finally by a list of the samples arranged with a running number and in chronological order. An appendix contains the list of species in each sample. As the result of the author's examination, he finds that Lake Kossogol itself possesses but a poor phytoplankton, the character of which is markedly alpine, the species being for the most part those peculiar to the Swiss lakes. Both species and individuals are few, and the diatoms are without special interest. The characteristic species are

* Oesterr. Bot. Zeitschr., lvii. (1907) pp. 146–52.
† Hedwigia, xlvi. (1907) pp. 365–420 (1 pl. and 1 map).

Dinobryon kossogolensis, *Sphærocystis Schroeteri* and *Stichoglœa olivacea*, var. *sphærica*.

The plankton of the ponds is quite different, and has the character of a pond plankton without any marked alpine tendency, the characteristic forms belonging to Myxophyceæ, Dinobryaceæ, and Peridineæ. Diatoms are, as in Lake Kossogol, of no special importance, with the exception of *Asterionella* in one lake. The great difference between the plankton of Lake Kossogol and that of the surrounding waters shows very clearly that the hydrographical and orographical conditions of a lake are at least of as great importance for the character of the plankton as its geographical position.

In the rivers there is no true plankton, the samples containing only a certain number of diatoms, Myxophyceæ, etc., which have been floated off from the banks.

With the exception of the new and characteristic species *Dinobryon kossogolensis* and a new variety of *Peridinum umbonatum*, all the forms from Lake Kossogol, as well as from the surrounding waters, are well-known species with wide distribution.

New South Wales Desmids.*—G. I. Playfair describes some new or less known Desmids found in New South Wales. He has studied these plants for the last fourteen years in three different localities, namely, Collector, at the northern end of Lake George; Moura, a private estate near Parkes; and some of the suburbs of Sydney. Up to the present only two papers on the Desmidieæ of New South Wales appear to have been published, one by S. Berggren and the other by Raciborski. The number of species recorded at present is about 350, of which 50 are doubtful or require further investigation, 230 have been definitely identified, and the remaining 70 form the subject of the present paper. Of these 50 species and 20 varieties and forms are new.

Pleurotænium.†—J. A. Cushman enumerates ten species of this genus, recorded from New England, and gives a key to nine of them, which he divides into three groups. The species are all comparatively large and conspicuous, and are easily distinguished from one another; four of them have not yet been recorded from the British Isles. All the species and varieties are more or less described, and references to literature are given. *P. indicum* has only once been recorded, and has never been verified since. It is omitted from the key to the New England species. It is said to have been found by Lagerheim at Tewksbury, Mass.; but though J. Cushman has examined much of the material from which Lagerheim took his Desmids, he has not succeeded in finding this species.

Diatom Flora of the Roman Bath near Budapesth.‡—J. Quint has already treated of this subject, and gives in the present paper the result of his further studies. In the introduction he deals with the collecting of the material, its preparation and preservation, and his methods of examination. For a mounting medium he recommends Grübler's

* Proc. Linn. Soc. New South Wales, xxxii. (1907) pp. 160–201 (2 pls.).
† Rhodora, ix. (1907) pp. 101–6 (1 pl.).
‡ Növényt. Közlem., v. (1906) pp. 74–86 (6 pls.).

styrax solution. He proved the existence of siliceous shells, 5 p.c. in the mud of the stream, and 3 p.c. in the crusts and slimy coatings of wooden objects. Some of the Bacillarieæ which live in the Bretter canal of the pond have gelatinous sheaths which can withstand the danger of drying up during the dry period when the sluice-gates are shut. Species of *Cymatopleura* in the stream show an inclination to saprophytism, for in their gelatinous sheaths are found other organisms. Five new species and varieties are described.

Sheath-forming Diatoms.*—M. Möbius describes instances he has observed of two species of sheath-forming diatoms growing inside the same sheath. He had previously published a note on this subject in his "Algal Flora of Java" in 1893. In that case he found a *Schizonema* growing—sometimes isolated, sometimes in chains—among the cells of *Homœocladia*. Now he describes the reverse case, a *Homœocladia* among the cells of *Schizonema*. The material in which this latter combination occurred was collected by Römer in a lake on the island of Kildin, on the north coast of Lapland. Marine, brackish, and fresh-water forms were represented in the collection. Among the diatoms were specimens of *Schizonema Grevillei*, in the sheaths of which were observed a small species determined as either *Homœocladia* or *Nitzschia dissipata* Grun. var. *media*. The distribution of this small species among the *Schizonema* varied, and instances are figured. The author found also another small species of *Schizonema* growing in the sheaths of *S. Grevillei*. The author alludes shortly to his experiences in the staining of sheaths of diatoms, and suggests the various effects of stains on different species as an aid to identification.

Œdogoniaceæ.†—K. E. Hirn publishes a critical résumé of the investigations and observations which have been made on Œdogoniaceæ in the years 1901–5, forming a supplement to the author's monograph and iconograph of the order published in Act. Soc. Sci. Fenn. in 1900. The present paper is divided into three sections: (1) The structure and development of the Œdogoniaceæ; (2) new species, varieties, and forms; (3) list of species mentioned in literature, or otherwise observed, since 1900, exclusive of new species. The first section deals with the results obtained by various authors as regards cell-contents, cell-division, germinating plantlets, oogonium malformations, the wintering of species under cultivation without formation of oospores, and the influence exercised by marine salts on the vegetation of certain species. To the results of these authors Hirn adds his own observations. The new species described since 1900 number 27 and 3 varieties, but the author considers 20 only of these are good, 6 varieties and 2 new forms. Complete information is now to hand about *O. paulense* and *O. pseudoboscii*. The third section adds many new localities, and remarks to species already recorded in the author's monograph.

Algal Cells in Convoluta.‡—F. Keeble and F. W. Gamble have made a study of the association of the green algal cell and the animal

* Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 247–50 (figs.).
† Act. Soc. Sci. Fenn., xxxiv., No. 3 (1906) 63 pp., 4 pls.
‡ Quart. Journ. Micr. Sci., li. (1907) pp. 167–219 (2 pls.).

cell in *Convoluta paradoxa*, and publish their results in the present paper, which is divided into the following sections: (1) Introduction; (2) proof of the origin of the green cells by infection; (3) the isolation of the infecting organism and the synthesis of the green *Convoluta*; (4) the life-history of the infecting organism; (5) the normal course of infection; (6) the significance and the consequences of the association of animal and green cell; (7) general summary. The infecting organism of *Convoluta* is found to be an alga belonging to the Chlamydomonadeæ, which in its free stage bears four equal flagella and possesses the general characters of members of this family. It may possibly be a species of *Carteria*. The active cells are of two sizes, but neither large nor small cells appear to be obligate gametes. The organism is capable of a saprophytic as well as of a holophytic existence; in the former state it may be colourless. The active cells are attracted chemotactically to egg-capsules of *Convoluta*. They settle down and undergo active vegetative division in the capsules, and are finally liberated as a swarm of four-flagellated active cells. The relation between green cell and animal changes with their development, passing from a symbiotic relation to one in which the animal is parasitic on the algal cells. The consequences of the association, so far as the algæ is concerned are, hypertrophy, nuclear degeneration, premature senescence, and death. The results of various experiments are shown by the help of tables. The paper is illustrated by two plates.

Unicellular Algæ and Alcyonaria.*—C. Gravier discusses the unicellular algæ which are found plentifully in all parts exposed to the light of certain Alcyonarias and coralline Polyps. He distinguishes two periods in the life of these organisms: the first, during which they are parasitic, and live in the interior of the mesoderm; the second, during which they provide for their own nourishment, and contribute at the same time to the support of the colony in which they live. In the first state they have the form of a sphere, about 8 μ in diameter, with hyaline protoplasm, and possessing one, rarely two, refringent bodies, the volume of which slightly exceeds that of the nucleus. They form an almost continuous covering near to the upper surface, and penetrate also into the endoderm. The second form of these unicellular algæ is quite different. They are less regular, generally elongate, and larger than in the first state, measuring along their greatest axis 18 μ. They are all situated in the mesoderm, where they form dense irregular ranks, frequently anastomosing. They multiply by bipartition.

Algæ of North Devon.†—C. E. Larter publishes a list of 137 algæ gathered by himself, E. M. Holmes, and others, in the botanical districts of Braunton and Sherwill, in North Devon. Among them is *Callymenia Larteri* Holmes, a new species collected at Combemartin by Larter in 1906, and without description here, but subsequently described and figured as *C. Larteriæ* in Journ. of Bot., xlv. (1907) p. 85. Notes on *Stenogramme interrupta* and *Nitophyllum Gmelini* are added.

* C.R. Acad. Sci. Paris, xxv. (1907) pp. 1462–4.
† Rep. Trans. Devon. Assoc., xxxviii. (1906) pp. 286–93.

Antarctic and Sub-antarctic Marine Algæ.*—C. Skottsberg publishes his report on the Phæophyceæ collected by him on the Swedish Antarctic Expedition in the following localities:—Sub-antarctic South America, Falkland Islands, South Georgia, Kerguelen and neighbouring islands, Tasmania, New Zealand and islands to the south, Graham's-land, South Shetland and South Orkneys, Victoria-land. He records 59 species, including several new to science, 4 new genera, and 1 new family, Ascoseiraceæ, which may, in the author's opinion, prove to be the oldest known type of Cyclosporeæ. Many of the species recorded are discussed at great length, notably *Macrocystis*, which is treated of from a morphological, anatomical, and systematic point of view. Another note deals with the inter-relations of the various genera belonging to the *Lessonia* group. Under the heading of general remarks, many interesting facts are noted, one of them being that the marine flora appears to be well developed in winter, even as regards the small epiphytic forms, and this applies both to the littoral and sub-littoral regions. Most of the species appear also to be fertile in winter. The paper is well illustrated by text figures and plates.

Sargassum lunense Cald.†—This species was collected at Spezia by L. Caldesi, and distributed by him in the Erb. Critt. Ital., No. 319 (1319) and in Rabenhorst's Alg. Europ., No. 1950. A. de Toni writes an account of this species, and discusses its affinities. In the form of the leaves, the absence of pores, size and disposition of the aerocysts, and form of the receptacles, it resembles *S. Hornschuchii* Ag., and differs from *S. linifolium* Ag. The author considers that *S. lunense* represents a long-leaved form of *S. Hornschuchii*, and suggests that special conditions in the Gulf of Spezia may have contributed to the determination of this variety—an hypothesis that could only be proved by experiment.

Dictyota dichotoma.‡—W. D. Hoyt has made a careful study of the periodicity shown in the production of the sexual cells of this alga, at Beaufort, N.C., and compares his results with those of Lloyd Williams, whose experiments were carried out at Bangor, in Wales. He finds that, as on the coasts of Wales and England, *D. dichotoma* produced at Beaufort its sexual cells at regular intervals, bearing a definite relation to the tides. The time of production of these crops, however, differs from that on the coasts of Wales and England, the crops being borne at monthly instead of fortnightly intervals. The assumption that light is the sole factor determining the time of fruiting does not hold for the plants of *D. dichotoma* growing at Beaufort. Specimens of *Dictyota* from Jamaica indicate that there, also, the sexual cells are produced in periodic crops, and that periodicity may obtain throughout the genus. The time of fruiting, however, at least in some cases, is different from that of *Dictyota* at Beaufort. Periodicity in the production of the sexual cells is not universal among the Dictyotaceæ. A species of *Padina*, probably *P. Durvillæi* Borg., bears antheridial sori of all ages

* Wiss. Ergebn. Schwed. Südpolar|Exped., 1901–3, iv., lief. 6, 172 pp., 10 pls., 1 map, 187 figs. in text.
† Atti Soc. Nat. e Mat. Modena, ser. 4, ix. (1907) 6 pp.
‡ Bot. Gazette, xliii. (1907) pp. 383–92.

on the same plant. Two charts show the tidal relations to the crops of *Dictyota* at Bangor and Beaufort respectively.

Anatomy of Phyllophora nervosa.* — W. N. Kononow gives an account of the anatomy of *Phyllophora nervosa* Grev., collected on the Chorly peninsula, in the Gulf of Karkenit. He treats of the habitat and habit of the plant; the formation of branches; assimilatory and mechanical tissues; storage-tissue and conducting-tissue. It requires special conditions for its growth; where the muddy clay gives way to firm shelly bottom, there the plant grows at a depth of 2–3 m.; and it can endure but little variation in its environment. Growth takes place by means of a three-sided apical cell. The assimilatory tissue is very early marked about 0·1 mm. from the apical cell. The chromatophores occur, not in the cortical tissue, but in the deeper layers of the assimilatory tissue. The whole alga is covered with a pectinous material. The mechanical tissue consists of a system of external buttresses, which is most developed near the base. The storage and conducting tissue occupy the innermost part of the thallus. The shapes of the different cells are described, with the pores in the cell-walls.

Polysiphonia.†—A. de Toni has made a study of 18 species of *Polysiphonia*, hitherto unpublished or but little known, from the herbaria of Zanardini and Meneghini. He publishes a diagnosis of each species, with a note as to its affinities, etc., giving at the same time the place and herbarium where the respective original specimens are preserved. This is in most cases the herbarium of G. B. de Toni, at Modena. Seventeen of the species are from the Adriatic and one from Tasmania.

Antarctic and Sub-antarctic Corallinaceæ.‡—M. Foslie describes the calcareous algæ brought home by the Swedish Antarctic Expedition, 1901–3, collected by C. Skottsberg. The collection contains 13 species, of which 7 belong to the genus *Lithothamnion* (2 being new), 4 to *Lithophyllum* (1 being new), 1 is an *Amphiroa*, and 1 a *Corallina*. The greater number of specimens were found at Staten Island, a few in the Beagle Channel, Fuegia, besides several from the Falkland Islands, South Georgia, and one from Louis Philippe Land. In a short introduction the author deals with the distribution of *Lithothamnion* and *Lithophyllum* in the antarctic region, so far as is possible from the material at his command; and he points out the various affinities between the antarctic species and those from other parts of the world. Two species which occur at the Falklands are so closely connected with two South African species, that the author was in the case of one species disposed to consider the differences as merely varietal. Critical notes are appended to each record.

New and Critical Coralline Algæ.§—M. Foslie publishes diagnoses and critical notes on a number of species of *Lithothamnion*, *Archæolithothamnion*, *Goniolithon*, *Melobesia*, *Litholepis*, and *Lithophyllum*. They come from all parts of the world, and include a few species collected by

* Scripta Bot. Hort. Univ. Imp. Petropol, xxiii. (1905–6) pp. 106–14 (1 pl.).
† Nuov. Notar., xviii. (1907) pp. 153–68.
‡ Wiss. Ergebn. Schwed. Südpolar Exped., 1901–3, iv. lief. 5 (1907) 16 pp., 2 pls.
§ Kgl. Norsk. Vidensk. Selsk. Skrift. 1906, No. 8 (1907) 34 pp.

Stanley Gardiner on the "Sealark" expedition to the Indian Ocean, which will be described more fully by Foslie in the Transactions of the Linnæan Society. The present paper forms the third part of his Algologiske Notiser.

Formation of Algal Paper.*—J. W. Harshberger describes felted masses of material collected on the margins of ponds, lakes and reservoirs in the United States. He finds it is composed of the matted remains of green algæ and diatoms that had been blown together by the wind and later dried so as to form sheets of so-called paper. Some of these consist of almost pure masses of one species, such as *Œdogonium fragile* or *Navicula* sp., and the felted mass varies in texture according to the species of which it is composed. Some of the sheets resemble an asbestos-like felt.

Nomenclature for Algæ.†—F. S. Collins calls attention to the Vienna rules of botanical nomenclature in so far as they apply to algæ. According to the present arrangement, all botanical nomenclature begins with the Species Plantarum of Linnæus, but the author contends that this work might be regarded as a "point" for starting, but certainly not as a "base," on account of the quite insignificant space devoted in it to cellular cryptogams. He considers that Nordstedt's plan of regarding Ralf's British Desmidieæ as the basis of nomenclature for Desmids is quite good, and though at first it may seem undesirable to have different starting points for different families of algæ, he believes that it may be the best solution of the problem. Nordstedt also proposes that three monographs dated 1888, 1893 and 1900 should be used for bases in their respective sections, i.e. Nostocaceæ, Heterocysteæ, Oscillarieæ, and Œdogoniaceæ. The author leaves it to the opponents of this system to suggest a better one.

Obituary of A. Le Jolis.‡—L. Corbière publishes a necrological notice and a portrait of Auguste François Le Jolis, b. 1823, d. 1904, founder and director of the Société Nationale des Sciences Naturelles et Mathématiques de Cherbourg. He reprints the speeches delivered over Le Jolis' grave by Corbière and Langlois, in which are many facts as to his life; and in succeeding lists he enumerates the societies with which Le Jolis was connected, the honours he received, and the works he published, several of which were concerned with marine algæ.

Obituary of F. R. Kjellmann.§—G. B. de Toni writes a short notice of the late F. R. Kjellmann, who died shortly before the Linnæan celebrations at Upsala this year. He was born at Torsö on Nov. 4, 1846, took his degree at Upsala in 1872, and in the same year was appointed a teacher in botany. He travelled in Nova Zembla, Siberia, and Spitzbergen between 1873 and 1875, and from 1878–1880 he took part as botanist in the voyage of the "Vega." From 1883 until his death he held the Chair of Botany at the University of Upsala. He published many botanical papers, of which a list is given; the two most important were the Algæ of the Arctic Sea and his Monograph of Galaxaura.

* Torreya, vii. (1907) pp. 141–2.
† Rhodora, ix. (1907) pp. 77–80.
‡ Mém. Soc. Sci. Nat. Math. Cherbourg, xxxv. (1905–6) pp. i.–xx. (portrait).
§ Nuov. Notar., xviii. (1907) pp. 121–5.

He contributed also to Engler and Prantl's Natürlichen Pflanzenfamilien the section which deals with Phæophyceæ.

BIANCHI, F.—**Ricerche su un laghetto Alpino (Il Lago Deglio).** (Researches on a small Alpine lake, Lake Deglio.)

[Enumerates the species of plankton and neritic benthos found in this small lake in the province of Como, together with physiographical data.]

Revista Geografica Ital., xiii. fasc. 4 (1906).

LARGAIOLLI, V.—**La varietà oculata del Glenodinium pulvisculus (Ehr.) Stein.** (The oculate variety of *G. pulvisculus*.)

[A description with figures of this new variety *oculatum*, which causes the particular coloration of Lake Tovel, in Trentino.]

Nuov. Notar., xviii. (1907) pp. 169–73.

MAZZA, A.—**Saggio di Algologia oceanica.** (Marine algology.)

[A continuation, which treats of several genera of Florideæ.]

Tom. cit., pp. 126–52.

SVEDELIUS, N.—**Über einen Fall von Symbiose zwischen Zoochlorellen und einer marinen Hydroide.** (On a case of symbiosis between *Zoochlorella* and a marine hydroid.)

[The first record of this phenomenon in a marine hydroid, the only case known being with the fresh-water species *H. viridis*.]

Svensk. Bot. Tidskrift., i. (1907) pp. 32–50.

TERRY, W. A.—**Causes of Variation in Colour in some Red Algæ.**

[The author describes some instances of this as occurring after desiccation in *Dasya elegans*. Specimens from different localities dry different colours, and these differences are constant for a given locality. This is attributed to the presence of different minerals in solution in the water at the respective stations.] *Rhodora*, ix. (1907) pp. 90–1.

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

Study of Synchytrium.*—Walter Rytz has made a biological and morphological study of a number of species of this genus. He based his work on *Synchytrium aureum*, which has been recorded on 125 different host-plants. Rytz took several of these hosts in separate localities on which the fungus was most richly developed and then co-related the plants in the neighbourhood that were living in the same conditions and that also had *Synchytrium* galls on their leaves, though to a somewhat less extent. He thus found that *S. aureum*, which had its chief habitat on *Lysimachia nummularia*, also attacked in a less degree species of *Potentilla*, *Valeriana*, *Hypericum*, *Epilobium*, and *Myosotis*. The place where these plants grew was liable at times to be overflooded, and at all times was damp. The fungus was formed towards the end of September.

In a quite different locality, where the plants were constantly washed with fresh water from a mountain stream, he found plants of *Saxifraga aizoides* very badly infected. The neighbouring plants that had similar galls were *Saxifraga stellaris*, *S. moschata*, and *S. androsacea*, with species of *Androsace*, *Hutchinsia*, *Leontodon*, *Viola*, and *Ranunculus*. This form he designates as *Synchytrium Saxifragæ*. In a similar manner he differentiates *S. infestans*, mainly on Leguminosæ, *S. Galii*, *S. vulgatum*, and *S. Wurthii*. He thus considers the large species *S. aureum* rather a collective form which has become more or less specialised according to

* Centralbl. Bakt., xviii. (1907) pp. 635–55, 799–825 (1 pl. and 10 figs.).

locality and conditions of growth of the hosts. The form of the galls corresponds more or less to these divisions, and may be reckoned as of specific character. Rytz gives a long account of other species, also describing the development and cytology of the different stages in their life-history. The paper is well illustrated.

Chytridiaceæ.*—J. Le Serbinow has made a special study of the genera in this natural order of fungi. He gives an historical account of them in the first part of his paper; in the second part, he recounts his own observations of their growth and development, and describes the different forms he has examined. He distinguishes three new genera: *Catenaria*, *Sporophlyctes*, and *Saccomyces*. The new forms are well illustrated.

Mildew of Spinach.†—R. Laubert examined the *Peronospora* that infests spinach and *Chenopodium*, supposed to be *P. effusa*. He found that there were morphological differences that separated the two fungi, and he makes a new species, *P. Spinaciæ*. The spores of the latter are larger and the sporophores are more sparingly branched. Mildew on spinach has never become an epidemic: only a few plants in a bed as a rule show the disease, as large yellowish spots on the leaves.

Formation of Abnormally Large Cells in Mucor.‡—G. Ritter has been experimenting on the influence on the growth of fungi of certain media, chiefly acids. He found a tendency to produce giant cells, especially in *Mucor spinosus*, when grown in a sugar solution with a definite addition of inorganic ammonia salts and a small percentage of organic acids. Ritter gives the quantities used by him that were most effective in bringing about this result. He suggests possible explanations of the phenomenon, but arrives at no definite conclusion.

Heterothallism in Rhizopus nigricans.§—Two papers have appeared recently in which the heterothallic nature of this mould is questioned or denied. The authors claimed to have produced zygospores on hyphæ arising from a single spore. A. F. Blakeslee * replies to the two writers in restating his own findings and in giving growth results obtained by him on material sent by Namyslowski, one of the authors in question. He restates his previous finding, that where zygospores are formed, there must be two strains, and where opposite results seem to have been obtained, the culture must have been impure.

Blakeslee ‖ also contributes a paper based on his work on *Mucor* to a discussion as to the biological significance and control of sex. He reviews the theories held by scientific workers on this subject, but he concludes that a further accumulation of facts is necessary before we are in a position to determine what, if any, unifying principle there may be in the wide-spread phenomenon of sexuality.

European Discomycetes.¶—Emile Boudier has published a volume containing the history and classification of the Discomycetes. He cites

* Script. Bot. Hort. Univ. Imp. Petrop., xxiv. (1907) pp. 5-173 (6 pls.).
† Gartenflora, xvi. (1906) p. 17. See also Bot. Centralbl., cv. (1907) p. 25.
‡ Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 255-66 (1 pl.).
§ Bot. Gazette, xliii. (1907) pp. 415-18.
‖ Science, n.s., xxv. (1907) pp. 366-72.
¶ Histoire et Classification de Discomycetes d'Europe. Paris: Paul Klincksieck, 1907, vii. and 221 pp.

the workers who have been devoted to this branch of mycology, and explains the reasons for attempting a new descriptive account of the group. His aim is to amplify and augment the classification he had already published in 1885. An account is given of the season, locality, and habitat of many of the more common forms, and a discussion follows as to the organs that are of value for classificatory purposes. He finds the leading feature in the manner in which the ascus discharges its spores—whether it opens by a lid at the top, or merely bursts. Under these two great groups of "operculés" and "inoperculés" he arranges his sections, families, and genera, with descriptions of each. Under the genera he gives a list of species, with the author and the place of publication. A full index completes the volume.

Notes on Myxotrichum.*—G. Ferro has revised the species of this genus that he found in the mycological herbarium of P. A. Saccardo. He retains in *Myxotrichum* the ascomycetous forms, these being *M. chartarum* and *M. ochraceum*. *M. deflexa* and *M. spelæa* are relegated to *Myxotrichella* as Hyphomycetes. Other species are found to belong to various Hyphomycetes, and one new genus is made, *Actinochæte*, to include an undetermined form. The illustrations are to be issued with the next number of the journal.

Research on the Cycle of Evolution of Pleospora.†—F. Cavara and N. Mollica examined the leaves of a plant of *Corypha australis* which had been attacked and badly damaged by a *Pleospora*. Besides the perithecia of *Pleospora* they found conidia of *Macrosporium* and *Alternaria*, and some fully formed sclerotia. Cultures and examinations showed that they were dealing with two forms—*Pleospora Alternariæ*, which was the cause of the disease, and *P. herbarum*, a saprophyte on the infected plant. They found that the sclerotia were those of the latter species, and they describe its formation and development, the growth of *Macrosporium*, and the development of the perithecia from the sclerotia. The asci arise from a binucleate cell of a lineal series of hyphæ in the fruit-body, the other hyphæ of the series became paraphyses. They emphasize the fusion of hyphæ that takes place after spore germination. They find in the sclerotium certain modified cells that are binucleate and others that contain four nuclei, which arise from the cell fusion of two binucleate cells; these cells give rise to the linear series of hyphæ. The authors represent in a schematic manner the cycle of evolution as they have followed it in their researches.

American Gooseberry Mildew.‡—E. S. Salmon has been making further investigations as to the spread of this fungus. He warns growers of the danger of neglecting to stamp out the disease, which as yet has not spread very widely in this country (it has been reported from three counties). He urges the Board of Agriculture to carry out the following measures: (1) the prohibition of all further importation of diseased gooseberry stock; (2) the compulsory destruction of all diseased bushes, compensation being paid when necessary. Illustrations are published of the disease in all its stages.

* Nuov. Giorn. Bot. Ital., xiv. (1907) pp. 221–34 (1 pl.).
† Ann. Mycol., v. (1907) pp. 119–49 (2 pls. and 4 figs.).
‡ S.E. Agric. Coll., Wye, 9 pp., 6 pls.

Pseudo-vacuoles of Yeast-cells and Development of Pseudo-cell nuclei.*—There have been many views as to the nature of the contents of the yeast-cell; J. J. van Hest has made a new series of researches, and presents new conclusions. He finds that the bodies considered to be nuclei in yeast-cells are only pseudo-nuclei, because they are already young yeast-cells; that the young cell-nuclei, when already independent, are ultramicroscopic; that the cells already formed are expelled from the mother-cell and do not arise by budding; and that the pseudo-vacuoles can be induced by starvation, in the course of which the cell-contents eventually disappear, evidently assimilated by the nucleus. As in favourable conditions the yeast-cells are round or oval, so, in less favourable, they are elongate and filamentous; these abnormal forms being rendered necessary in the search for food. He finds that the young nucleus possesses a membrane; when it stretches, a second is formed, and then a third. The earliest form of the nucleus is not demonstrated; it must be excessively minute, as the young cell which he names primary cell is also extremely small. When this primary cell is large enough to be seen by the ordinary powers of the Microscope, it is already a secondary cell, and gives rise to primary cells. Thus, the yeast-cell itself is not the place where the "earliest" nuclei appear: they arise in the cell within the yeast-cell. The cells that the "secondary" throws out escape through the outer wall of the yeast-cell, and grow into yeast-cells. In this fully grown, fully developed yeast-cell, he finds that the three membranes of the nucleus are still there; the outer membrane has become the wall of the yeast-cell, the secondary incloses the secondary cell, the third membrane the primary cell. Finally, van Hest finds that pseudo-vacuoles have no existence: they are an optical illusion.

Wildier's Bios.†—Pure yeast-cells increase and give rise to fermentation only in the presence of a certain organic substance termed Wildier's Bios. M. Ide has made a series of experiments to determine the nature of the "bios." He finds that it is a comrade of cholin, and is widely dispersed, as it comes from lecithin fats. A discussion follows on the advantage or necessity of the presence of bios, etc., and results are given of various experiments. Finally, as a further test, the isolation of biosin is to be attempted.

Uredineæ‡.—E. W. D. Holway has just issued the part of the "North American Uredineæ" dealing with *Puccinia*. He records and describes forms on 15 different natural orders of plants. Holway has not adopted Arthur's nomenclature, though he records his names among the synonyms. The paper is illustrated by reproductions of microphotographs of the teleutospores.

W. A. Kellerman § publishes a decade of the *Fungi selecti Guatemalensis*, all of them species of the Uredineæ; some of them are on new hosts, others are new species recently described.

* Centralbl. Bakt. xviii. (1907) pp. 767–87 (3 pls.).
† Tom. cit., pp. 193–9.
‡ North American Uredineæ, i. part 3, Minneapolis, 1907, pp. 57–80 (13 pls).
§ Journ. Mycol., xiii. (1907) pp. 99–102.

The same writer has also published * an explanatory account of Arthur's new nomenclature and arrangement of the Uredinales, which have been divided into three families—Coleosporaceæ, Urediniaceæ, and Æcidiaceæ. The different genera falling under these families are enumerated, and reasons given for their position in the system devised by Arthur.

P. Magnus † contributes new observations that he has made on species of *Uromyces* collected in the Tyrol from plants of the natural order Leguminosæ. He has made a more exact study of the markings on the teleutospores and of the germinating pores. He was not able so easily to correlate differences in the uredospores. The facts discovered have enabled him to fix the identity of several species.

Deformations caused by Uredineæ.‡—Ed. Fischer cites two instances of excessive alteration of tissue caused by the mycelium of a fungus —the witches' brooms formed by *Melampsorella caryophyllacearum* on Conifers, and the *Æcidium* of *Uromyces Pisi* on *Euphorbia Cyparissias.* In the latter case the leaves are broader and shorter and the whole shoot longer. In general, alteration takes place on the axis by elongation of the internodes, swelling of the stem, and by increased or suppressed branching. On the leaves of the host, there is often abnormality of form, and, in one case, *Æcidium leucospermum* induced the change of vegetative leaves to flower leaves. Finally, in the effects on the flowers there may be total suppression, or, more frequently, dwarfing of the floral organs.

Mycetozoa.

MASSEE, G.—**Philippine Myxogastres.**
[A list of mycetozoa from the Philippine Islands, all of them already known to science.] *Phil. Journ. Sci.*, ii. (1907) pp. 113–15.

NADSON, G., & A. RAITSCHENKO—**Zur morphologie von Enteromyxa paludosa Cienk.** (On the morphology of *Enteromyxa paludosa* Cienk.)
[The authors describe the growth and development of the organism, which they consider to be a primitive Myxomycete.]
Script. Bot. Hort. Univ. Imp. Petrop., xxiii. (1905–6) pp. 74–6 (4 pls.).

Lichens.

(By A. LORRAIN SMITH, F.L.S.)

Mediterranean Lichens.§—The Lichens of the Islands Linosa and Lampedusa, in the vicinity of Sicily, have been collected by G. Zodda, and determined by G. Albo, who now publishes them with some notes. Linosa is exclusively volcanic, and rises to a height of 200 metres, while Lampedusa is formed entirely of dolomitic limestone. Owing to this diversity of soil the lichen flora is very different, the only species common to the two islands being *Rocella tinctoria*, *R. pygmæa*, *Physica parietina*, and *P. aureola*. The writer lists 47 different forms for the two islands.

* Journ. Mycol., xiii. (1907) pp. 89–94.
† Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 250–5 (1 pl.).
‡ Ver. Schw. Nat. Gesell., lxxxix. (1907) pp. 170–7.
§ Bull. Soc. Bot. Ital., 1907, pp. 42–6.

Anatomy of Parmelia Species.*—F. Rosendahl has made a study of the brown species of *Parmelia*. He finds that they can be divided into two groups. (1) Those with a many-layered cortex, and (2) those in which the cortex is one or at most two cells thick. Fat-cells have been found in the cortex of some species, and in two species short trichomes on the upper surface. Rhizoids possess a pith and cortical sheath : they arise from the lower cortex. Respiration is provided for in *P. aspidota* by pores on the upper surface. The author notes two types of Isidia, (1) those that never show soredia, and (2) those that finally become sorediate. The acids that are found in these species are also given.

Gall-formation in Lichens.†—Several cases of gall-formation have already been established in lichens; W. Zopf has recently described some others of considerable interest. In the species *Ramalina kullensis*, recently discovered on the island of Kullen, he found that some of the strap-shaped branches were deformed and much swollen. The deformed parts bore spermogonia, but very rarely apothecia. He found occasional holes in the thallus, remains of excrementa, and parts of some articulated insects. Finally he found abundant evidence of the presence of mites, spiders, and *Diplopoda*. Further research convinced him that the deformations were due to the mites. He applied his discovery to a re-examination of species of *R. scopulorum* var. *incrassata*, and found that it was nothing less than a specimen of *R. scopulorum* deformed by galls. He has no doubt that *R. cuspidata* var. *crassa*, will also turn out to be a gall species.

HAHN, GOTTHOLD—**Das Vorkommen seltner Flechtenarten an ein und demselben Standorte in unseren Lokalflora.** (The presence of rare lichens in one neighbourhood of local floras.) *Jahresb. Gesell. Naturw. Gera* (*Reuss.*) 1906, pp. 102–3. See also *Hedwigia*, xlvi. 1907, beibl., p. 110.

LESDAIN, BOULY DE—**Lichens rares ou nouveaux pour la Belgique.** (New or rare lichens for Belgium.)
[A series of lichens collected on sand dunes, and varying from the types on account of their habitat.] *Bull. Soc. Roy. Belg.*, xliii. (1907) pp. 249–54

STEINER, J.—**Flechten.**
[Lichens in H. Penther and E. Zederbauer's "Results of a Natural History Expedition to Erdschias-Dagh (Asia Minor). One new species and several new varieties are described.]
Ann. Nat. Hofmus. Wien, xx. (1905) pp. 369–84. See also *Ann. Mycol.*, v. (1907) p. 204.

ZAHLBRÜCKNER, A.—**Vorarbeiten zu einer Flechtenflora Dalmatiens. IV.** (Preparation for a lichen-flora of Dalmatia.)
[The number for the district reaches 327; several new species are included.]
Oesterr. Bot. Zeitschr., lvii. (1907) pp. 19–30, 65–73 (1 fig.). See also *Ann. Mycol.*, v. (1907) p. 204.

ZOPF, W.—**Zur Kenntnis der Flechtenstoffe.** (The knowledge of lichen constituents.)
[Describes the acids in a large number of species, some of them being new.]
Liebig's Ann. Chemie, ccclii. (1907) p. 1-44. See also *Ann. Mycol.*, v. (1907) p. 205.

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* Inaug. Diss. Münster, 1907, 35 pp. See also Ann. Mycol., v. (1907). pp. 203–4.
† Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 233–8 (1 pl.).

Schizophyta.

Schizomycetes.

Bacillus neigeux.*—Jungano has isolated this organism from cases of cystitis, gangrenous infiltration of the perineum, and pyonephrosis. The bacillus resembles *B. perfringens*: it is non-motile, stains uniformly with aniline dyes, and also by Gram's method. It only develops under anaerobic conditions, growing well on glucose at 37° C., and forming, after 18 hours, small white points which under a low power have the appearance of bone-cells with canalicular prolongations; after 24 hours, development is completed as dense masses of irregular finely arborescent colonies, resembling flakes of snow; there is no production of gas; at 22° C. growth takes place more slowly, colonies only appearing at the bottom of the tube after 5–6 days; it does not grow on gelatin; broth is uniformly clouded at the end of 24 hours, and after 36 hours becomes completely clear, with a deposit at the bottom of the tube. It does not form spores; subcutaneous injection of guinea-pigs and rabbits causes an induration which disappears after 4–5 days without suppurating; but intraperitoneal injection is fatal to guinea-pigs and white rats after 6–10 days.

Pseudo-tuberculosis in Sheep.†—J. A. Gilruth describes the morphology and pathology of this disease that attacks a large percentage of all sheep brought to the export slaughter houses of New Zealand. It affects chiefly the pleura and lungs, but also the lymphatic glands. The author has isolated from a precrural lymphatic abcess a specific organism. This is a short irregular sized bacillus $0 \cdot 5$–1μ long by $0 \cdot 3\mu$ in breadth; it stains well by Gram's method. Growth occurs most readily on solidified, clear ox-blood serum, small grey punctate colonies appearing after 24 hours at 37° C.; these increase in size to 3 mm. by the third day, having a raised darker centre and an irregular periphery of yellow tint, and a yellow feathery zone radiating from the edge of the colony into the substance of the serum, this aureole increasing until the whole of the medium is occupied by growth. In sheep serum the growth is greyish white and the feathery zone is absent or not observable; broth cultures show a thin pellicle and a powdery deposit on the sides and bottom of the tube; growth on agar was obtained by subculturing from serum, and consisted of a powdery looking streak with irregular borders; in all cultures the growth was very tenacious. Microscopically the bacilli appear in masses or chains; on agar and glycerin-agar the bacilli are very short and resemble streptococci. Growth occurs on gelatin after 5–8 days, but it is not characteristic; no growth was obtained on potato; there is a good growth in milk at 37° C., with the formation of a thick brown deposit, the milk remaining unaltered. Experimentally the disease was conveyed to sheep, guinea-pigs, and rabbits. The pathogenic action of the bacillus resembles that of the tubercle bacillus in the general appearance of the nodule, in the progression of the disease from gland to gland with ultimate affection of the lung.

Referring to observations made in other countries, the author men-

* C.R. Soc. Biol. de Paris, lxii. (1907) pp. 677–9.
† Div. Vet. Sci. N.Z. Dept. Agric., Bull. 1, 1903.

tions a disease described by Nocard as "Lymphangitis simulating farcy" in horses, and which is due to a bacillus morphologically and culturally similar to the organism described above.

Braxy-like Mortality among Sheep.*—J. A. Gilruth reports a braxy-like epidemic occurring among sheep, particularly hoggets feeding on turnips, and due to a specific organism which was isolated from the heart-blood and from other parts of the animals dead from the disease. The organism is a short anaerobic bacillus occurring in pairs and forming spores; it grows readily on agar at 37° C., giving rise to a slight production of gas; broth is clouded after 24 hours; growth on gelatin is slow and inconstant; it stains by Gram's method.

The disease differs from braxy in the small gas-production and in the absence of the characteristic offensive odour.

Experimentally the bacillus was pathogenic for sheep and guinea-pigs.

Immunisation against Anthrax.†—J. A. Gilruth finds from the results of numerous experiments that guinea-pigs, rabbits, and sheep can completely resist the inoculation of large doses of virulent anthrax bacilli, provided these organisms are mixed with a large quantity of some other organisms that are non-pathogenic for these animals. The anthrax bacilli must be mixed with the other organism, for if injected at different parts of the skin no resistance results. An animal which has suffered with absolute immunity a large dose of anthrax bacilli mixed with a foreign organism may succumb later to a much smaller dose of pure anthrax culture. Immunity to large doses of pure anthrax could be conferred on rabbits and sheep, which received repeated doses of both anthrax and Gaertner bacilli in increasing quantities.

Micro-organisms in Acute Rheumatism.‡—E. W. A. Walker considers that this disease is probably caused by a micrococcus which he and other observers have isolated on a large number of occasions from subjects of the disease, both during life and on post-mortem examination. The organism has been seen microscopically in rheumatic lesions, in the synovial membrane of joints, in the cardiac valves, and in the meninges in cases of acute rheumatic chorea, and has been cultivated from a rheumatic nodule. On injection into animals it produces morbid lesions similar to those of acute rheumatism. It has the appearance and general cultural characters of a streptococcus, but it produces a considerable amount of formic acid, which is not known to be produced in like quantity by streptococci obtained from other sources. Though many competent observers have failed to find any micro-organism in acute rheumatism, and various objections have been raised against the acceptance of this organism as the cause of rheumatism, the author sees no reason to abandon positive results in favour of purely negative evidence, and claims that the *Micrococcus rheumaticus* is a distinct variety of streptococcus.

Chromogenic Variations of Micrococcus prodigiosus.§—G. Peju and H. Rajat find that the normal pigment-production by *Micrococcus*

* Div. Ver. Sci. N.Z. Dept. Agric., Bull. 2, 1903.
† Op. cit., Bull. 7, 1904.
‡ Brit. Med. Journ., 1907, i. p. 1233.
§ C.R. Soc. Biol. de Paris, lxii. (1907) p. 792.

prodigiosus does not require an acid reaction of the medium; an acid reaction intensifies the pigment, but kills the organism rapidly. By growing in slightly alkaline medium the intensity of the pigment diminishes gradually until the death of the micrococcus, all shades of colour from bright red to yellow and white being observed. It is possible also to obtain an identical series of diminishing tints by the addition of progressively increasing quantities of alkaline salts.

Bacillus coli in Oysters.*—A. Gautié has compared the numbers of *B. coli* in oysters taken direct from the pools at Cette, and to which cases of typhoid had been traced, with oysters from Marennes taken from the market at Toulouse. The bacteriological analyses of the water in the shells and of the bodies of the oysters were made separately. The results showed that *B. coli* was present in 26 out of 30 specimens of the oysters from Cette, and only in 5 out of 30 of those from Marennes.

Capsule of Bacillus anthracis.†—T. Stiennon finds that the encapsuled anthrax bacilli which appear in an infected subject, or in cultures grown on ascitic fluid, blood-serum, etc., are not phagocytosed and kill more rapidly than the non-encapsuled bacilli of ordinary cultures. It seems there exists in the blood some product which the bacterium utilises to form its capsule, which shields it from the phagocytes and assists it in overcoming the resistance of the subject.

Agglutinability of the "Bacillogène" of Tetanus.‡—G. Rosenthal has investigated the agglutinability of cultures of bacillogène of tetanus in 24-hour old broth. The addition to one drop of the culture of one drop of anti-tetanic serum gave an immediate agglutination; with a dilution of 1 in 10, agglutination resulted in half an hour; with a dilution of 1 in 400, in two hours; and with 1 in 500 only a slow partial agglutination. The positive reaction with 1 in 400 being superior to the agglutination of 1 in 100 obtained with normal serum, indicates the retention of specific properties by the culture. A mixture of one drop of culture and one drop of anti-diphtheritic serum gives incomplete agglutination after a quarter of an hour; in a 1 in 10 dilution no sign of agglutination occurred after an hour and a quarter.

Homogeneous Cultures of Bacillus mesentericus.§—Lafforgue has grown *B. mesentericus* in broth so that the characteristic pellicle was not formed and the culture presented a homogeneous appearance. This was attained by two methods. (1) Subcultures were made from the clear broth drawn off from beneath a pellicle at definite intervals of time-care being taken that the pellicle remained intact. The earlier speci, mens still formed pellicles, though more slowly, but those taken after 96 and 120 hours gave no pellicle and formed perfectly homogeneous cultures. (2) A 5-day old broth culture is sterilised and filtered, the filtrate is inoculated with a fresh *B. mesentericus*, and a uniformly clouded homogeneous culture results.

The author finds that the filtrate, as compared with the initial broth,

* C.R. Soc. Biol. Paris, lxii. (1907) p. 766.
† Tom. cit., p. 821.
‡ Tom. cit., p. 784.
§ Brit. Med. Journ., 1907, i. pp. 884, 1177, 1195.

shows a disappearance of albuminoid matters, an increase in alkalinity and in oxidising power, and considers that these conditions are favourable to the production of homogeneous cultures, and that the growth of *B. mesentericus* in meat broth produces a decomposition of albuminoid matters, some of the derivatives of which increase the alkalinity and oxidising properties of the medium.

Coccus anomalus.* — P. Mazé and P. Pacottet have examined a number of wines of Champagne affected with "maladie du bleu" from which they have isolated the *Coccus anomalus*, and to the development of which organism they attributed the cause of the disease. The same organism has been isolated from many other varieties of wine.

New Species of Streptothrix.†—R. Caminiti has isolated a streptothrix from the air. Colonies in hanging-drop showed thick granular darker centres, with smoother, thinner and paler peripheries with irregular circumference, from which and from the surface of the colony numerous threads were projected, the colonies consisting of netted and branched threads; these stained by analine dyes, by Ziehl's carbol-fuchsin, and by Gram's method, In old cultures the colonies consist of masses and chains of granules and rods lying among a few threads, and resulting from the fragmentation of threads. In broth, it formed white colonies like small powder puffs, some depositing and others forming surface pellicle, the medium remaining unclouded. Growth occurs on gelatin after 3–4 days, the medium being slowly liquefied. The most vigorous growth is obtained on glycerin-agar. Growth on milk is slow and on the surface, and usually of a dark green colour; the reaction of the milk is amphoteric. Growth on potato is vigorous and quick, forming white to yellow or greenish, sometimes pink, colonies, which unite into an irregular expansion. It is a potential anaerobe. It is pathogenic for laboratory animals. The author gives a general account and classification of the *Streptothrix* group.

Protozoon-like Organism in Human Saliva. ‡ — V. Ellermann found in the saliva of nine out of thirteen individuals a small round organism 20–30 μ in diameter, and possessing an irregular, often rotatory movement which was most active at 20° C. They were only observed in fresh saliva, and if this was kept in a dish until the following day, no organisms were to be seen. The organism consisted of two parts that varied in relative proportion, the one being dark and refractile, the other pale and resembling a vacuole. In contrast to cocci these organisms are usually solitary, and not grouped in pairs or clumps. Oval forms with refractile substance at either end were met with, and suggested a process of division. Neither flagella nor cilia were observable by the staining methods employed. The author considers that these organisms must be regarded as Protozoa.

Two Anaerobic Streptococci.§—H. Gräf and W. Wittneben describe two streptococci isolated anaerobically, the one from a cutaneous abscess that suggested actinomycosis, the other from an abscess in the brain.

* C.R. Soc. Biol. Paris, lxii. (1907) p. 141.
† Centralbl. Bakt., 1te Abt. Orig., xliv. (1907) p. 193.
‡ Tom. cit., p. 160.
§ Lancet, 1907, ii., p. 97.

The first appeared as diplococci or short chains of irregular-sized cocci, or frequently as curved round-ended rods staining variously by Gram's method; the cocci have no true motility, and possess neither capsule nor flagella; optimum temperature is 37° C.; aerobic growth only occurs when the medium contains both serum and sugar. The organism is only slightly pathogenic for laboratory animals. The second appeared among the pus cells of a brain abscess, when stained by Gram's method, as masses of small cocci, arranged in chains of four to eight members. Ordinary surface cultures on neutral-, glucose-, glycerin, and blood-agar, and on Loeffler's serum, showed no growth after 24 hours; but under anaerobic conditions abundant growth was obtained; no growth could be obtained on gelatin at room temperature. The organism was not pathogenic for laboratory animals. The authors give in tabular form the cultural characters of these two organisms, whereby they are contrasted with each other and also with *Streptococcus pyogenes*.

Thermophile Bacteria.*—P. Bardou isolated four varieties of *B. thermophilus* from the lower layers of fluid in the open tank of the sewage works at Lille. In the tank they lived at an average temperature of 15° C., but their optimum temperature for culture is between 52° C. and 60° C. They are motile, form spores, and liquefy gelatin; under anaerobic conditions they coagulate milk, the clot being subsequently dissolved; they stain badly with ordinary aniline dyes, but well by Ziehl's and Gram's methods.

Acid-fast Bacilli.†—Lombardo Pellegrino finds that the relation between Koch's tubercle bacillus and the pseudo-tubercle or acid-resisting bacilli, is analogous to that which exists between the species of one genus, or between the varieties of one and the same family of organisms.

The relation between acid-fast bacilli and the tubercle bacillus of birds and cattle and the diphtheria bacillus is understood when these organisms are all regarded as members of the large family of Streptotricheæ. The acid resistance is caused by fatty matter which has been formed as the result of metaplastic processes in the bacillary protoplasm.

Carriage of Infection by Flies.‡—R. M. Buchanan records experiments in demonstration of the part played by flies in carrying and spreading infection. The flies used were *Musca domestica* and *M. vomitoria*. The bacteria used were those of typhoid fever, swine fever, pyosis, tuberculosis, and anthrax. The experiments showed conclusively that flies alighting on any substance containing pathogenic organisms are capable of carrying away these organisms in large numbers on their feet, and of depositing them in gradually decreasing numbers on surface after surface with which they come into contact. They further serve to demonstrate the necessity for the exercise of stringent measures to prevent the access of flies to all sources of infection, and to protect food of all kinds against flies alighting on it.

Anaphylaxia and Anti-anaphylaxia.*—A. Besredka and E. Steinhart find that guinea-pigs, after receiving a dose of anti-diphtheritic

* Centralbl. Bakt., 1te Abt. Ref., xxxix. (1907) p. 744.
† Tom. cit., p. 753.
‡ Lancet, 1907, ii., pp. 216–18 (5 figs.).
§ Ann. Inst. Pasteur, xxi. (1907) pp. 117–384.

serum, become extremely sensitive to intra-cerebral injection of normal horse-serum, if this last is given within 10–12 days after the first injection. This hypersensitiveness or anaphylaxia results in very severe symptoms that often terminate fatally. If the horse-serum is injected into the brain or peritoneum after the interval of 12 days, it is innocuous, and may act as a vaccine, the state of anti-anaphylaxia being produced, so that now the animal no longer succumbs to the intracerebral injection of serum. The brain, spleen, liver, and serum of a guinea-pig rendered anti-anaphylactic have no specific properties.

The anti-anaphylactic vaccination, whether obtained by intra-peritoneal or by cerebral injection, belongs very probably to the same order of phenomena as the de-intoxication in vitro of the tetanic brain by anti-tetanic serum; the vaccination having the effect of restoring the guinea-pig to its original condition. The anti-anaphylactic immunity will then be only the natural immunity that all normal guinea-pigs possess against the intra-cerebral injection of serum.

Bacillus proteus ruber.*—L. Fortineau and Soubrane have studied *B. proteus ruber*, isolated from the water of the Loire. The microbe presents a curious polymorphism which is dependent on the age of the culture, on the medium, and on the temperature at which it grows. On agar the growth is red; broth is clouded, there is a superficial border, and a red deposit; the growth on serum is pink; milk is slowly coagulated; gelatin very slowly liquefied; there is abundant growth on potato. In young cultures, on agar and in broth, at room temperature, the bacilli are 2–4 μ long, often joined as diplobacilli, and staining by Gram's method; after 20 days they have elongated into filaments or streptobacilli associated with clubbed forms, a condition that persists for some months. On serum, clubbed forms appear within four days, and are often very large and curved rods; short bacillary chains, and long sinuous threads and forms resembling spermatozoa, are noted.

Grown in an incubator, these variations in form appear at an earlier date. The organism is not pathogenic for laboratory animals.

Toxæmia produced by Dead Bacillus mallei.*—J. Cantacuzène and P. Riegler find that dead glanders bacilli are toxic, and produce, when inoculated either intra-peritoneally or by the intestinal tract, a disease that is more or less rapidly fatal, with symptoms of lowered temperature, emaciation, and degeneration of the renal epithelium and heart-muscle fibre; the polymorphonuclear leucocytes, often engulfing the bacilli, undergo an acute necrosis; in the protoplasm of the more resistant leucocytes there is a production of an amorphous substance that stains bright green by thionine; the blood shows an increase in the number of the lymphocytes. The destruction of the dead bacilli is very rapid; they soon lose the power of fixing basic aniline dyes; they persist for a short time as eosinophil granules, but after 1–2 hours become completely invisible.

The authors describe and give illustrations of the manner in which the dead bacilli pass through the intestinal wall.

* C.R. Soc. Biol. de Paris, lxii. (1907) p. 1214.
* Ann. Inst. Pasteur, xxi. (1907) p. 194.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Old Microscope by Jackson.—The Microscope (fig. 87) was presented to the Society at the October Meeting, 1902, by Mr. John

Fig. 87.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

Jackson (see this Journal, 1902, p. 721), and is an interesting type, being the forerunner of the well-known Jackson-Lister model. The foot is of the flat horse-shoe form, carrying two turned brass pillars, to which the limb is attached by means of a cross-bar working through centres at the top of the pillars. The limb is grooved its entire length, and has V-shaped fittings in which the body, mechanical stage and substage work. One side of the V fitting is screwed on to the limb, so that any wear can be compensated for.

The rack-and-pinion movements to body and substage are actuated by milled heads placed behind the limb.

The mechanical stage has rack-and-pinion movement in both directions, and is also provided with a micrometer screw and lever fine-adjustment. The substage sliding-piece also carries the mirror, which is a plane one only, mounted in gimbals.

The substage condenser, which consists of a Huyghenian eye-piece with wheel of diaphragms placed between the lenses, has a tinted glass cap for modifying the illumination; the lenses also are so arranged that either can be easily removed when not required.

The body of the Microscope is of large size, and is provided with a draw-tube.

The mahogany box into which the instrument packs also contains the following apparatus:—3 eye-pieces, one of which is provided with a Jackson screw micrometer; $1\frac{1}{2}$-inch objective, by Jas. Smith, with lieberkuhn; $\frac{4}{10}$-inch objective by Jas. Smith, with lieberkuhn, and correction collar; $\frac{1}{4}$-inch objective by Smith and Beck, 6 Coleman Street; stand condenser, stage forceps, tweezers, box of dipping-tubes, live-box, dark-well and carrier, and stage micrometer.

A New Microscope and its Applications to Stereoscopic Photomicrography, by A. Quidor and A. Nachet.*—This instrument (fig. 88) satisfies with a single apparatus all the requirements of the laboratory—minute dissections, histology, cytology, photomicrography, photographic enlargements, or diminutions. Its main purpose, however, is to obtain the stereoscopic presentation of objects examined or dissected. Two cases may be distinguished according to the size of the objects:—

1. When the object can be examined only by a Microscope.
2. When the object can be examined either with a loup, or without a loup.

(1) The general arrangement of the Microscope resembles that of ordinary instruments. But, whilst the object-stage remains horizontal, the over-stage M with the objective O is jointed at C, and is inclinable to the right and the left of the plane of symmetry, the amount of inclination being measured by the index E. Moreover, a rod bearing a photographic camera with a frame for receiving slides of ordinary stereoscopic form can be placed instantaneously above the Microscope, the camera being connected on by a double tube T, which effectually shuts out all exterior light. The Microscope is now inclined at an angle α to obtain on the side B of the sensitive plate a first photograph of an object in the focus of the objective O, situated at the apex

* Original communication. See also Comptes Rendus, cxliv. (1907) pp. 908–10 (1 fig.).

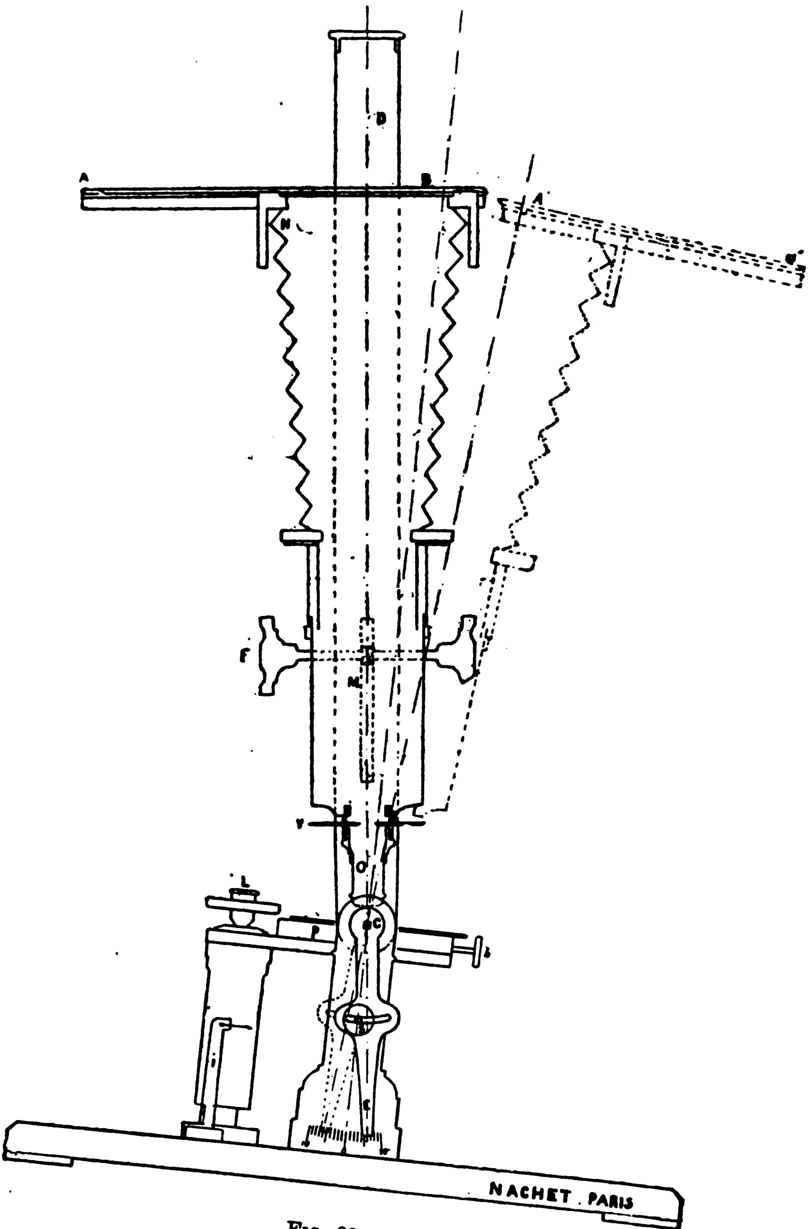

Fig. 88.

of articulation C; then a second photograph is obtained on the part A of the plate under an inclination symmetrical with the first. The two views are thus obtained on the same stereoscopic plate in the order in which they should be observed to give the sense of relief, thereby avoiding the necessity of inverting the proofs, which has to be done with an ordinary stereoscope. In certain special cases—e.g. when the relief of the object and the depth of the objective render photography impossible, the photographic image of an object can be replaced by two drawings made with the camera-lucida at different angles; these two drawings juxtaposed and viewed in the stereoscope give also a good stereoscopic presentation. It is essential that the object should be at the exact level of the axis of rotation C. To obtain this arrangement a method suitable for medium magnifications is to place the object approximately at the level of C, the Microscope tube being vertical; the tube is then inclined; if the object no longer remains in the centre of the field, it is either too high or too low, and correction must be made with the micrometric screw. With high magnifying powers the following method is best. The objective O is first focused on the surface of the stage P, whose coincidence with the plane of the axis is indicated by the index I. Then a preparation, whose thickness is, of course, variable, is placed on the stage P; the object is thus necessarily higher than C, and must be made to descend by the required amount to the level of C by a movement of the micrometric screw L, the exact focus being at the same time obtained. But the rackwork F must not be touched, nor the original position of the objective O modified in any way.

(2) When the objects to be dealt with exceed 15 mm. the camera is rotated 180° around its rod; it is then behind and away from the Microscope. Into the tube T a photographic objective of low magnifying power is now introduced, and the object is arranged on a shelf at the level of C. In this way the enlargement varies from 3·5 to 1. Exactly the same arrangement suffices for the diminution (from $\frac{1}{3}$ to $\frac{1}{15}$) of too large an object.

The authors state that, in comparison with ordinary binocular methods, their Microscope yields a photographic field 1·5 to 4 times larger, according to the extension of the bellows. The great value of their instrument, however, consists in the means of stereoscopic photography with high powers, whereas with binocular Microscopes the photographic enlargement is very limited, inasmuch as their principle depends on the juxtaposition of two equifocal objectives, with necessarily short frontal distance. Moreover, binoculars necessitate photographing on two half-plates, instead of on a single plate of ordinary size.

Nachet's Oscillating Stage for Stereoscopic Microphotography.* A. Guieysse, who was working on this subject simultaneously with, but independently of, MM. Quidor and Nachet, conceived the idea of an oscillating stage, the Microscope, of course, remaining stationary. He afterwards discovered that, so far back as 1866, Moitessier had hit upon

* C.R. Soc. Biol. de Paris, lxiii. (1907) pp. 18, 19 (1 fig.).

the same idea. Ultimately, with the collaboration of M. Nachet, Moitessier's design was reconstructed and improved. The arrangement, viewed from behind, is seen in fig. 89. The stage, composed of a plate RR perforated by an aperture, is applied on the stage of the Microscope, and carries the oscillating system formed of an axis pivoting around O, and bearing the oscillating stage PP with its screw-supports C. Behind, the axis is traversed by a horizontal bar BB, carrying at its extremities two screws C intended to limit the movement of oscillation, which can be controlled in advance by an index marking on a drum the degree of displacement. A screw A can lower the stage below the axis of rotation so as to neutralise the thickness of the object-glass. In using the apparatus it is first centred with the help of a disk, which is pierced by a small hole, and which has to be applied in the central aperture. The disk is then replaced by the preparation, and the screw

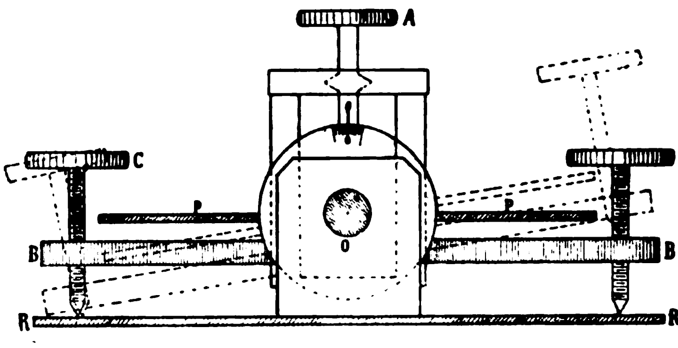

FIG. 89.

A regulated to such an extent as to reduce to a minimum the lateral displacement of the object-glass in the movement of oscillation. The stage is then inclined alternately on each side, and photographs taken.

Microscopical Observations at High Temperatures: Gas-heat Condenser and Air-Cooling Apparatus.*—The apparatus referred to above is due to O. Lehmann of Karlsruhe, and completes the adaptation of his crystallisation Microscope to projection purposes. The firm of Carl Zeiss supply these auxiliaries in such a form that they can be immediately fitted to their ordinary Microscopes, which are then suitable both for subjective observation, for the projection of the formation of fluid crystals, and for observation of heated preparations. The Gas-heat condenser (fig. 90) is inserted with the push-tube (*a*) into the push-collar of the Abbe illuminating apparatus under the Microscope, in lieu of the ordinary condenser, and then clamped. It consists of: the polariser (*b*); the iris diaphragm; the illuminating lens; the gas-burner

* Special Catalogue, Carl Zeiss (Jena), 1906.

(*d*); and the heat-guide (*l*). The polariser *b* is rotatory about an excentric axis and can be swung into, or out of, the ray path. The position of its polarising plane can be read off on the graduated scale which is shown in the figure. At insertion the tooth *n* engages in the notch *k*. The polariser is a Grosse Air-Nicol, whose side is twice as large as its length. It is rectangular in cross section, and has a side length of 25 mm.; its shortness and large aperture make it very useful here on account of the small available space. The iris diaphragm is placed immediately above the polariser, and is provided with a handle *g* for regulating the aperture of illumination; during observations it is in general to be kept fully open. With a central stop in the objective the iris secures dark ground illumination. Immediately over the iris is

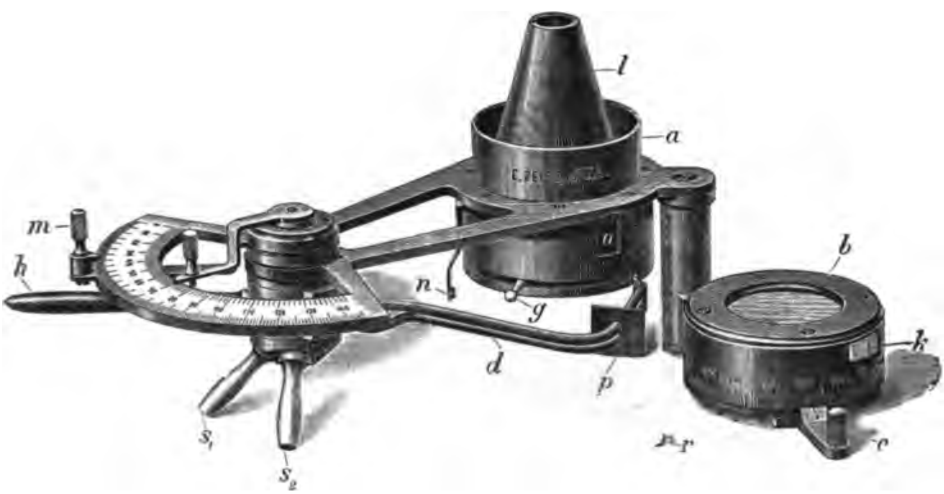

FIG. 90.

the unspherical illuminating lens (not visible in figure), which induces a good combination of the illuminating beams and thereby secures an increased brightness, a matter of great importance in projection. Between the illuminating lens and the preparation the controllable gas-burner *d* is applied and is pushed in and out by the lever *h*, being passed in through the aperture *o* until the aperture is closed by the plate *p*; the effect of the plate is to exclude lateral air-currents. After insertion the burner stands over the middle of the illuminating lens. The burner is adapted for heating the preparation to comparatively low temperatures (100°–200°), as well as to high temperatures (about 700°). It is constructed with two tubes, one for gas and one for air. In the case of low temperatures, however, only one tube is used, viz. that one whose nozzle is marked G. The gas supply is regulated by the handle *m*, which operates an index moving over the outer graduated circle. The

burner is so arranged that increase of the gas supply, so long as the index is on the first half of the scale, is comparatively slight; but on the second half each scale division implies a greater increase of gas supply. In heating to high temperatures, gas is admitted through the other nozzle *s*, air being passed through G, and the small cap *r* is screwed on to the point of the burner. The two scales serve, first, to afford an accurate mark for the adjustment of the burner; secondly, to provide a method of applying a systematic course of heating. As the heating of the preparation, when the flame is very small and therefore

FIG. 91.

comparatively far from the preparation, is not lateral to the axis, the heat-guide *e* is inserted from above through the stage aperture of the Microscope. This guide is a conical brass tube with an external asbestos coat.

The attainment of a temperature constant for a long time is assisted by a downward cooling, which, moreover, steadies the under heating. Lehmann's air-cooling arrangement (fig. 91) used for the purpose is made of a brass rod of rectangular cross section perforated with an air-canal. This canal has on its upper side two openings on which, by means of air-tight ball-joints, two adjustable air-tubes are placed. In the long axis of the brass rod there is, on one side, a nozzle for the air-supply and on the other a regulating screw for the strength of the air-current. The brass rod is fitted on both sides with projecting arms so arranged that the whole can be laid around the flange at the foot of the upper part of the Microscope used, and can be tightened by a screw. The arms vary in form according to the flange, and are so adjusted that their maximum effect is exerted on opposite sides of the field of view. The

air is supplied under pressure, and by combination of the gas-burner and air-supply, any desired temperature can be maintained for a long time in the centre of the field.

Zeiss Heat-Microscopes.*—Figs. 92, 93, 94, show various forms of these instruments. Fig. 93 is Lehmann's Crystallisation Microscope

Fig. 92.

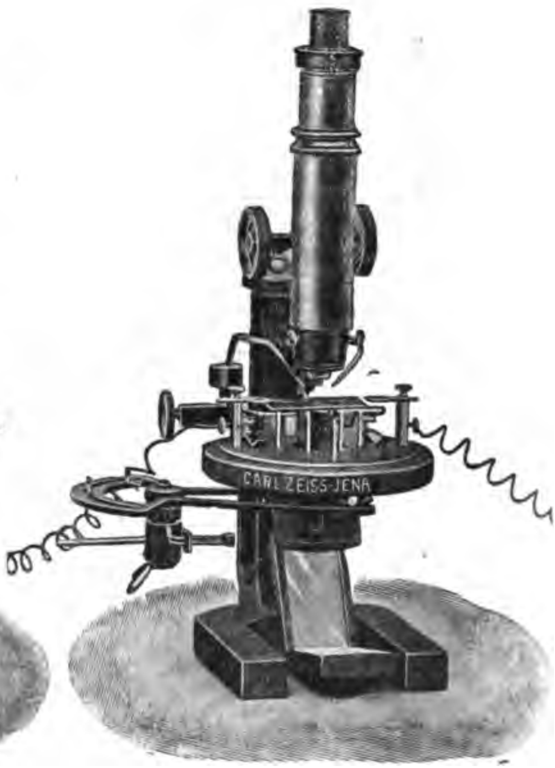

Fig. 93.

arranged for subjective observation at high temperatures. Fig. 92 is a new Physico-Chemical Microscope for subjective observation and projection at high temperatures (900° C.) fitted with a gas-heat condenser, an air-cooling arrangement, and a polarising apparatus.

* Special Catalogue, Carl Zeiss (Jena) 1906.

Fig. 94 is for the instantaneous photomicrography of heated objects (e.g. molten crystals) with simultaneous subjective observation.

Koristka's Large Model Stand IIe.*—This instrument (fig. 95) corresponds to the stand IIc on page 21 of the maker's catalogue N 12.

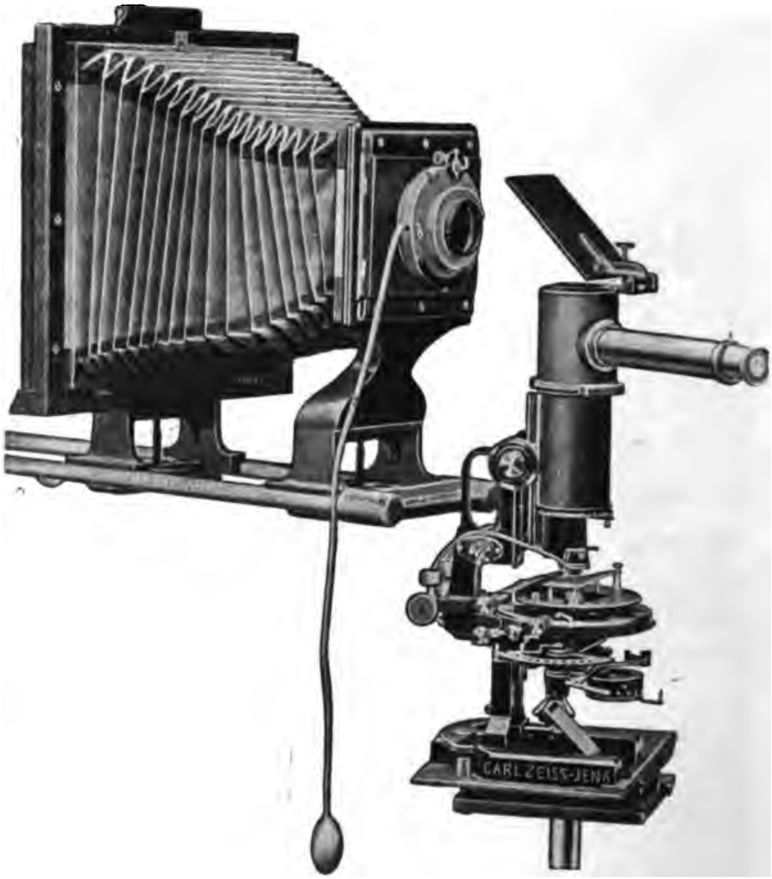

FIG. 94.

It is fitted with a complete Abbe apparatus (condenser of N.A. 1·40) and iris diaphragm; diaphragms are introduced by a cylinder into the condenser. The circular ebonite stage has a diameter of 110 mm.; it is rotatory, and is governed by clamping screws for the adjustment of the preparation. The tube of the objective-holder is of ample dimen-

* Supplement to General Catalogue N 12, Milan, April 1907.

sions to adapt it for photomicrography. The model may be compared with the figs. of IVa., pp. 101–2, of this Journal, 1905.

FIG. 95.

Martens Ball-jointed Metallographic Preparation Microscope.*—This instrument is shown in fig. 96, and is intended to be used for observing the progress of the polishing and etching operations required to adapt specimens for metallography. As is evident from the figure, the stand here takes the form of a double ball-jointed arm. By this means the specimen can be viewed at any angle. In order to avoid any

FIG. 96.

risk of injury to high-priced objectives and oculars, which might arise from the proximity of the etching and polishing substances, a special series of achromatic objectives and Huyghenian oculars is supplied by Messrs. Carl Zeiss.†

Voigtländer and Sons' Large Mechanical Stage.‡—This is designated No. 1 by the makers. Its character will be understood from

* C. Zeiss' Catalogue, entitled "Estimate for an Outfit for the Photomicrography of Metals," Jena, March 1907; and Martens and Heyn, "Ueber die Mikrophotographie im auffallenden Licht und über die mikrophotographischen Einrichtungen der Königtech. Versuchanstalt in Charlottenburg (Mitt. Königtechnik Versuchanstalt, Berlin, 1899, p. 85).

† Tom. cit., p. 5.

‡ Catalogue (English Edition) 1907, p. 17.

fig. 97. It has a range of 30 and 45 mm. in both directions, which can be read on three scales with verniers.

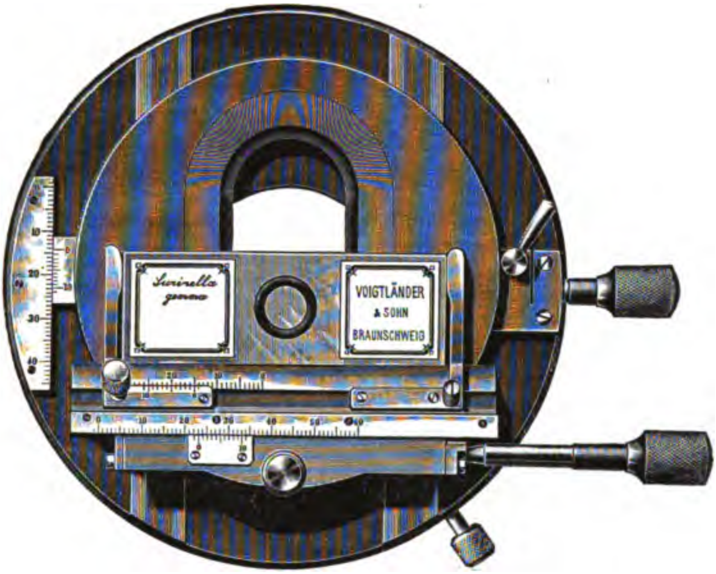

Fig. 97.

(2) Eye-pieces and Objectives.

Siedentopf's Microscope Ocular with Quartzwedge Compensator.* This ocular with push-action quartz wedges resembles that described by J. Amann.† It has the shape of the ocular screw-micrometer ‡ except that the lateral measuring drum is omitted and in lieu thereof an opening is contrived into which the quartz wedges can be pushed. Fig. 98 shows the ocular with the wedge, and fig. 99 shows the wedge by itself. The whole arrangement is dropped into the Microscope tube, thus replacing the usual ocular, and clamped. The ocular is a Ramsden, and the wedge operates in its focal plane. The optical axis of the wedge is parallel to its long sharp angle, and the wedge is adjustable in direction of its length. On its upper face is a graduation which gives in thousandths of a millimetre the retardation difference experienced by the ordinary and extraordinary rays in their respective cross-sections as they pass through the wedge. When the polarising planes of the polariser and of the analyser (inserted on the ocular) are crossed and inclined at 45° to the principal plane of the quartz wedge, and so placed on the preparation under examination that the polarising plane of the quicker wave lies perpendicularly to the optic axis of the quartz wedge,

* Extract from Centralbl. f. Min. etc., 1906, No. 23; published by Carl Zeiss, Jena.

† Zeitschr. wiss. Mikrosk., xi. (1894) p. 440–54. See also this Journal, 1895, pp. 237-40.

‡ Zeiss' Catalogue, Mikroskope, 1906, p. 33.

and that of the slower wave parallel to the optic axis, then the phase-retardations in the preparation and in the quartz wedge are placed in opposition. It is possible, therefore, to push the wedge into such a position that these opposite retardations are equal and neutralise one another. At this cross-section of the wedge a black band will appear, whilst to its right and left are coloured bands similar to the colours of their plates. When this adjustment is attained, the before-mentioned retardation difference in the preparation is read off. In order to attain extreme accuracy without too long a wedge, three interchangeable wedges are supplied corresponding to retardation-differences in the proportion of 0–2, 2–8, and 8–39. The first wedge consists of two quartz wedges whose axes are perpendicular to each other, and a scale-

Fig. 98.

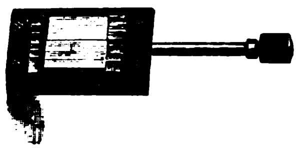

Fig. 99.

division corresponds in their case to a retardation difference of $0 \cdot 01\ \mu$, thus enabling $0 \cdot 001\ \mu$ to be easily read. The other wedges are similar in principle. The line selected as standard is the green quicksilver line $\lambda = 546\ \mu\mu$.

Determination of the Properties of Objectives.—A. E. Conrady gives the following report of a demonstration by F. W. Watson Baker at the Quekett Club on May 17, 1907, dealing with the determination of the equivalent focus of objectives by Abbe's method, with the measurement of their numerical aperture, the difference between ordinary and compensating eye-pieces, and with methods of testing the correction of objectives.

Determination of the Equivalent Focus of Objectives (according to Abbe).—By this method two observations of a stage micrometer with different tube-lengths are made to yield the true equivalent focus of an objective and also the position of its upper focal plane. The principle is clearly shown in fig. 100, where O Q represents an objective producing an image A B of an object *a b*. As A B is a sharp focused image of *a b*, it follows that all rays of light passing from points in the object through the object-glass are re-united in the corresponding points of the image, and therefore any single ray of light proceeding from a point in the object through the object-glass, is a geometrical locus of the image, and is sufficient to determine its size at any given point of the optical axis.

The most convenient ray to employ for this purpose is the one proceeding from a point such as b in the object in a direction parallel to the optical axis. Such a ray after refraction passes through the principal focus F of the objective, and if the incident ray from b and the refracted ray passing through F are produced until they intersect at b', then by definition a plane $b' a'$ perpendicular to the optical axis and containing this point is the upper cardinal plane of the objective, and its distance a' F from the principal focus of the objective, or the upper focal plane as it is usually called, is the equivalent focus of the objective.

Now, it is immediately apparent that $a' b'$ F and A B F are similar triangles, and as $a' b'$ is equal in size to the object $a\,b$, and a' F is the

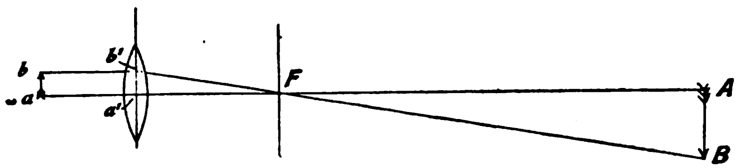

FIG. 100.

equivalent focus, we can immediately deduce the proportion, that A B, the size of the image, is to $a\,b$, the size of the object, as the distance A F between image and upper focal plane is to a' F, or the equivalent focus of the lens. Or in mathematical form

$$(\mathrm{A\,B} \div a\,b) = (\mathrm{A\,F} \div a'\,\mathrm{F})$$

$(\mathrm{A\,B} \div a\,b)$ is the magnification of the image A B, and we will introduce the symbol M for this, as well as the symbol f for the equivalent focus of the lens, and our expression thus becomes

$$\text{I.} \qquad \mathrm{M} = (\mathrm{A\,F} \div f)$$

which is the simple equation used in Abbe's method of determining the equivalent focus, all the apparatus required being a stage micrometer and an eye-piece micrometer divided to the same unit, that is to say both in fractions of millimetres or both in fractions of inches.

As is obvious from the diagram, no lens must intervene between the objective being measured and the magnified image A B, and if the eye-piece micrometer is to be used in the usual Microscope eye-pieces of Huyghenian type, it is absolutely necessary that the field-lens of the eye-piece be removed, as otherwise totally erroneous results must be obtained.

By observing how many divisions of the eye-piece micrometer correspond to a division of the stage micrometer, we determine directly the magnification M in our equation I.

By measuring off the position of the eye-piece micrometer with regard to the upper end of the Microscope tube, we can also determine the point A in our diagram, but the point F cannot easily be determined by the same method, and therefore both quantities of the right hand side of our equation must be regarded as unknown and two observations

with different tube-lengths will be necessary to determine both. Two such observations give us two equations:

$$\text{II.} \qquad \begin{aligned} M_1 &= (A^1 F \div f) \\ M_2 &= (A^2 F \div f) \end{aligned}$$

and subtracting the second from the first we obtain

$$M_1 - M_2 = (A^1 A^2 \div f)$$

which, transposed and put into ordinary language, means that the equivalent focus of the objective is equal to the increase of tube-length between the two experiments divided by the resulting increase of magnification of the primary image.

The equivalent focus having thus been determined, it can be introduced into one of the equations II.; for instance, the first of them; and will then determine the distance $A^1 F = M_1 \times f$; and the position of A having been measured off in the manner suggested above, it is a simple matter to lay off the length $A^1 F$, and thus to determine the point F usually described as the position of the upper focal plane of the objective.

In the experiments shown at the demonstration, an 8 mm. Holos objective was employed with a short tube-length. It was found that one space of $\frac{1}{10}$ mm. of the stage micrometer covered 18·6 similar spaces in the eye-piece micrometer. When the tube had been lengthened by 73 mm., it was found that one space of the stage micrometer now covered 28 spaces of the eye-piece micrometer. An increase of tube-length of 73 mm. had therefore produced an increase of magnification of 9·4 times; and on dividing the first number by the second, according to the above rule, the equivalent focus of the objective is found to be 7·8 mm. Multiplying the latter figure by the magnification found in the second measurement, it was found that the upper focal plane lay 217 mm. below the eye-piece micrometer, and making the measurement suggested above, this led to fixing the upper focal plane itself at a position 14 mm. below the shoulder of the standard screw. It should be mentioned that when Professor Abbe introduced his system of nomenclature when bringing out the apochromatic objectives, the angular magnification assigned to the compensating eye pieces was based on the assumption that the upper focal plane of the objectives should lie 32 mm. below the shoulder of the standard screw. It follows, therefore, that if the position of the upper focal plane differs from this, as indeed it does in the case of the above 8 mm. Holos objective, the magnification obtained according to Abbe's rule by multiplying the initial power of the objective into the angular magnification of the eye-piece will give a wrong result, and to compensate for this, opticians occasionally purposely mis-state the equivalent focus of objectives in order that the magnification determined by Abbe's method may come out approximately correct. Thus, in the case of our example, it would appear at first sight as if the objective, being of 7·8 mm. focus instead of 8 mm., would magnify about $2\frac{1}{2}$ per cent. too much. As a matter of fact, this is heavily over-compensated by the circumstance that its upper focal plane lies 18 mm. higher than Abbe's assumed

position, making the optical tube-length 252 instead of 270 mm., so that for this reason it would magnify about 7 per cent. too little.

The result of the combination of both effects is, therefore, that the Holos 8 mm., although really of 7·8 mm. focus, nevertheless magnifies nearly 5 per cent. less than a true 8 mm. fulfilling Abbe's assumption as to position of focal plane.

Determination of Numerical Aperture.—Three Microscopes were adapted to demonstrate the use of the Abbe apertometer and certain dangers to be avoided. The latter refer to the probability of obtaining too low a reading when measuring objectives or condensers with a large

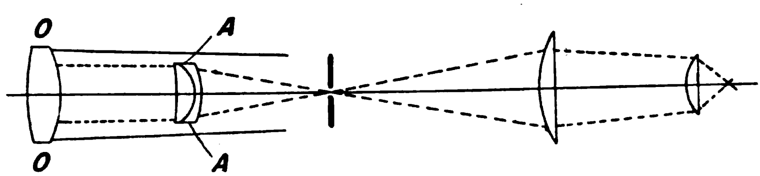

FIG. 101.

clear aperture, owing to the auxiliary Microscope not having a sufficiently large field to receive light from the marginal zone of objectives and condensers of this type. Figs. 101 and 102 show clearly how this trouble arises, and the causes to which it is due.

In fig. 101 it is shown how the cone of rays proceeding from the large objective O O is of too large a diameter to be completely received by the auxiliary objective A A supplied with the apertometer, the result

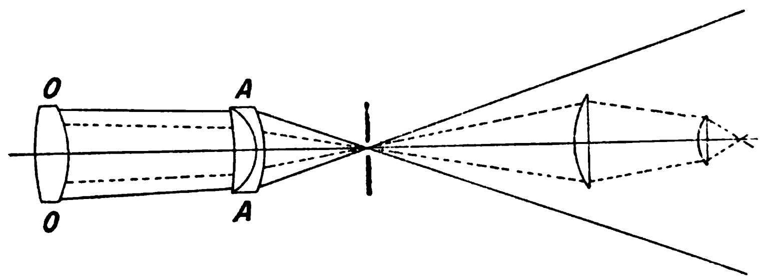

FIG. 102.

being that only light corresponding to the dotted cone enters the auxiliary Microscope, and that if a measurement is attempted under these conditions, the numerical aperture of the dotted cone instead of the full cone will be obtained.

Another way in which the trouble arises is illustrated in fig. 102. In this case the auxiliary objective A A is large enough to receive all light coming through the objective O O, but owing to an excessively long draw-tube, or to the fact that an eye-piece of too high a power is used, the marginal part of the light is spread out too much to enter the eye-piece, and is thus cut off at this end of the instrument; and by

tracing back the amount of light which can enter the eye-piece, it is again found that the marginal zone of the objective is cut off, and that too low a result will be obtained in this case also.

The remedy in all such cases is to do away with the auxiliary Microscope altogether, and to observe the back of the objective to be measured by looking directly at it down the Microscope tube, for as this danger only exists in the case of unusually large clear apertures, it is quite easy and accurate to observe without a magnifying instrument.

Numerical Aperture and Resolution.—A neat contrivance was also shown to demonstrate the fact that resolving power increases with aperture. The instrument simply consisted of four pieces of wire netting, graduated in fineness and mounted in a suitable frame, and of a plate with four perforations of different diameters, placed at a suitable distance from the frame, so that the latter might be observed by looking through any of the perforations. The distance between screen and perforations being adjusted so that when looking through the largest perforation all four meshes could be distinctly seen, it was found that on looking through the next smaller perforation only three of the meshes were resolved, the finest appearing without detail; the still smaller perforation would resolve only the two coarser meshes, and the smallest perforation would only show the coarsest of all. A complete analogon was thus provided of the effect of aperture in either telescope or Microscope.

Ordinary versus Compensating Eye-pieces.—In order to demonstrate the difference between ordinary and compensating eye-pieces, two Microscopes were set up side by side, one fitted with a strictly achromatic objective, calling for an ordinary eye-piece, the other fitted with a Holos objective, requiring a considerable compensating effect in the eye-piece. Two Holos eye-pieces were accurately adjusted, one to suit the achromatic, the other to suit the Holos objective, and visitors were invited to notice the effect of exchanging these eye-pieces, in order to dispel the rather prevalent idea that there was some special virtue in compensating eye-pieces to which a great part of the excellence of modern objectives was due; the exchange producing either good images in both Microscopes or else bad images in both Microscopes, the latter being characterised by the appearance of broad coloured fringes on the edges of the silver lines of the Abbe test-plates which were employed as objects; and it was pointed out that the only special effect produced by the compensating eye-piece was that it has a higher magnifying power for a red object than for a blue object, and as the modern high-power objectives with unachromatic thick front lens have a similar difference of magnifying power in the opposite direction, the compensating eye-piece, if properly adjusted, will produce an image free from colour fringes on such objectives.

Tests for Objectives.—Another four Microscopes were shown demonstrating the use of the Abbe test-plate for examining objectives and determining the nature of their defects.

The first of these instruments showed how spherical aberration can be readily detected by shifting a comparatively narrow cone of light gradually from the central to the marginal zone of the objective under test, either by using the usual turn-out ring of the substage, or, more

conveniently, by use of a mechanical substage with rack-and-pinion movement, by means of which the iris can be set centrally or excentric at will. When spherical aberration is present in an objective, the different zones focus at a different level, and consequently if the light is changed from central to oblique without changing anything else, the lines of the test-plate will go out of focus if spherical aberration is present, and the latter will thus be immediately detected.

It was pointed out in this connection, that on the same principle an extremely sensitive test for spherical aberration might be obtained by using a condenser stop of such size and so decentred that it just reached from the centre to the margin of the objective, and then noticing whether the two edges of the test-plate line running across the centre of the field were sharply in focus simultaneously.

It is said that by this method of observation the correct tube-length of a high-power objective can be determined within one or at most a few millimetres.

In a second Microscope the same excentric stop was employed for testing the chromatic correction of an objective. The aperture in the substage should in this case be quite small, so as to test a very narrow zone of the objective at one time. Under these conditions, the edges of the lines of the test-plate show complementary colours, which in the case of a perfectly corrected modern objective should be apple-green and purple or claret-colour, no matter what zone of the objective other than the central one is tested.

The achromatic objectives of the older type show a continual change of the secondary colour-tints when the stop is moved from the centre to the edge of the aperture. They usually show a bluish-green, or even blue, instead of the apple-green near the centre of the aperture, and a yellow, or even orange, instead of the apple-green in the marginal zone.

The third of the Microscopes in this section was fitted with a badly centred objective, the result being that when the light had been carefully centred and adjusted, unsymmetrical colour fringes and fogginess became apparent on the edges of the lines of the test-plate. One-sided defects of this kind with carefully centred illumination are nearly always due to centring defects in the objective, but may sometimes be caused by the stage not being accurately square to the optical axis, or to a badly mounted object having its cover-glass similarly out of square to the optical axis.

The fourth of these Microscopes showed the importance of either using the correct thickness of cover-glass or else compensating the effect of change in this respect by altering the tube-length, or by using a correction collar. The 4-mm. Holos objective had been correctly adjusted to the thinnest cover-glass on the Abbe test-plate. By moving the mechanical stage so as to bring the adjacent thickest cover-glass under the objective, the excellent image obtained in the first case was immediately replaced by a hopelessly bad image caused by the change of cover-glass thickness.

In an adjoining room, the Watson-Conrady apparatus for photomicrography had been set up, and its distinctive features were fully explained and the method of using it demonstrated.

As shown in fig. 103, the apparatus consists of a comparatively small but fully corrected condensing lens C C, mounted in close proximity to an iris diaphragm I I. About 12 in. from the condensing lens, there is mounted an auxiliary iris A A, and close to this a simple lens L L. The Microscope is set up at such a distance from the auxiliary iris that its substage condenser S is in the right position to throw a sharp image of the auxiliary iris upon the object to be photographed. The adjustment of the apparatus is such that the main condensing lens C C throws a sharp image of the source of light centrally upon the auxiliary iris A A, which latter image is then focused by the substage condenser S upon the object on the stage. The auxiliary simple lens L L is approximately of the right power to form an image of the iris I I upon the back lens B B of the substage condenser. The purpose of this lens is thus to prevent the spreading out of the light passing from the source through the condenser C C by bending the cones of rays near the auxiliary iris A A, so as to direct them centrally upon the substage condenser in the manner clearly shown in the diagram. The characteristic feature is, therefore, that all scattering of the light is completely prevented.

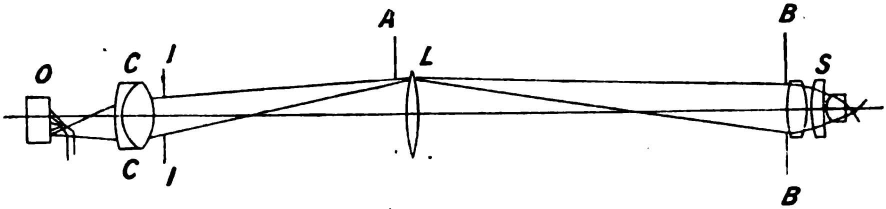

FIG. 103.

To adjust the apparatus, the auxiliary iris diaphragm should first be placed at a distance from the substage condenser equal to the distance from the lamp flame for which the substage condenser is corrected—generally about 8 inches.

The substage condenser should next be centred, after which the auxiliary iris should be closed and its image focused centrally over the object to be photographed by using the centring screws of the auxiliary iris and the focusing movement of the substage condenser. The next step is to adjust and focus the source of light and the Watson-Conrady condenser, so as to produce an enlarged image of the brightest part of the source of light centrally on the auxiliary iris. The iris of the Watson-Conrady condenser is now to be closed so as to fill the substage condenser completely with light whilst preventing an excess of light from flooding the surroundings. A satisfactory image may then be produced on the focusing screen in the usual way, but before making an exposure the auxiliary iris should be carefully closed until it begins to reduce the size of the picture on the screen. This final step shuts off all false light from the outer parts of the object, beyond the portion to be photographed.

(3) Illuminating and other Apparatus.

Kaiserling's New Model of a Universal Projection Apparatus.* This apparatus is made by E. Leitz of Wetzlar, and its general character

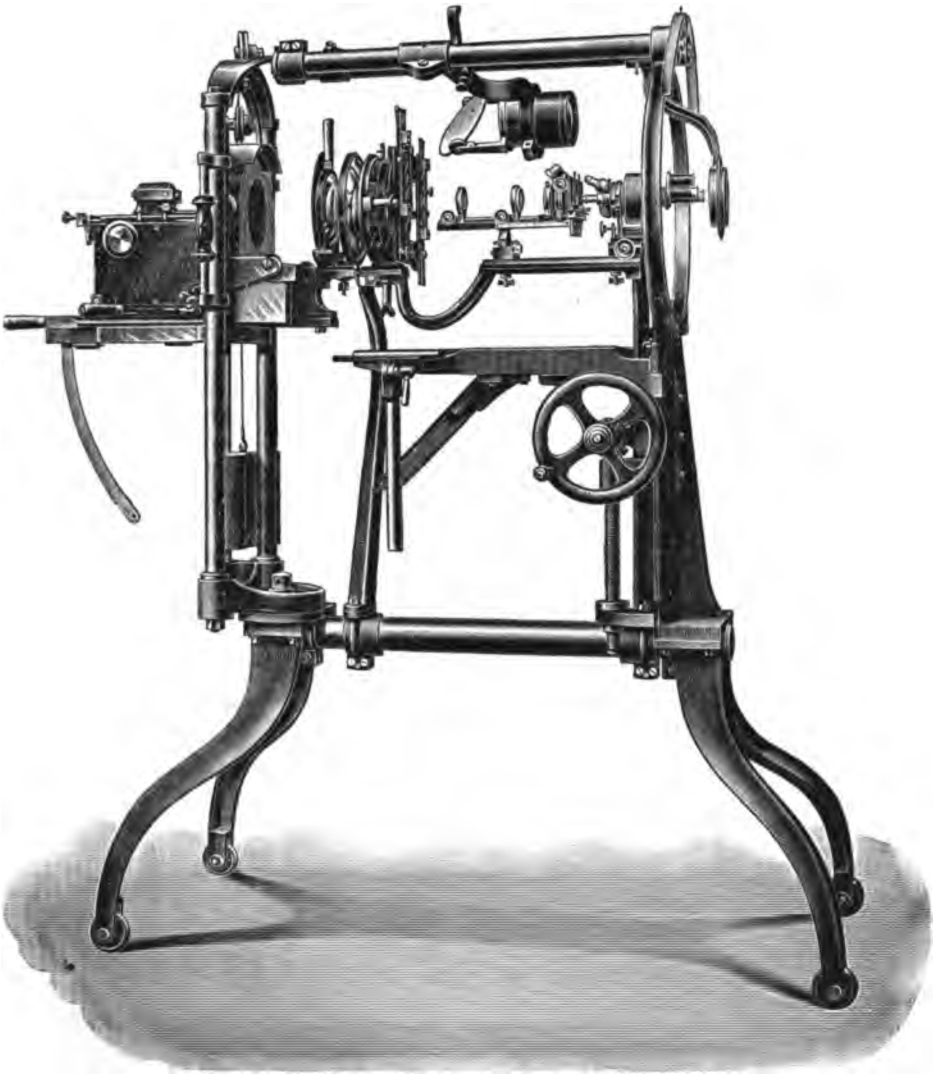

FIG. 104.

is shown in fig. 104. The base is formed of two pairs of cast-iron bent legs mounted on rollers and connected together by a very strong

* Zeitschr. wiss. Mikrosk., xxiii. (1906) pp 440–8 (7 figs.).

horizontal steel rod. The hinder pair supports the double lamp-carrier rotatory about a vertical axis. A Thomson lamp may be used as the light source; but a better result is obtained from a 30-ampere lamp with right-angled carbons. This lamp is adjustable in the optic axis by a lever. The usual vertical, horizontal and lateral centrings of the light-source are now reduced to a perpendicular and lateral adjustment of the lamp itself, a great gain in the case of an inexperienced demonstrator. The lamp, moreover, whilst being moved up and down on its carrier-pillars, is counter-balanced by a weight. This vertical movement is, however, only required in the case of change to diascopic projection of large section with right-angled reflected light. Both of these centric positions are firmly secured by clamps. The rotation of the lamp through 45° to the normal optic axis serves for the projection of objects situated in a laterally incident light. On the front pair of legs stands a bearer of T-section diminishing upwards and carrying in its grooved lower part the guide-nut for the perpendicularly movable large object stage for the macroscopic objects. The bearer also carries the adjustment arrangement of this stage operated by a cranked wheel. At its top end the bearer develops into a circular frame for the reception of the diaphragm arrangement. A strong horizontal steel rod finally connects it with the lamp-carrier, and serves as a holder of the large projection objective; it also carries a diaphragm adjustable in the optic axis, and on this diaphragm the screen-cloth is screwed. [The screen-cloth is not shown in the figure.] The large condensers are mounted on the horizontal lamp bearer, and both lenses are free for convenience of cleaning. Lamp and condenser are arranged for tilting. The appliances necessary for micro- and diapositive projection are so mounted on an optical bench, which is fastened each way on two long T-carriers, gripping the connected rod of the legs, that they can be moved either way. They are held in centric and lateral position by strong clamps. In order to diminish the possibility of a wrong position of any of the parts, and to facilitate exchange of diapositives, the optical bench is bowed underneath like a handle. The cooling trough and the diapositive holder are placed on the short arm. The author illustrates the details of the various methods of projection by suitable figures, one of which also shows the convenience of the bow in the bench as affording hand-room in exchanging diapositives, as above mentioned.

New Model of a Simple Movable Object Slide.*—G. Schorr has found the following contrivance very useful in dealing with serial sections. A slab of glass, about 3 mm. thick and 9 × 13 cm. surface, has a semicircular excision in one of the long edges, and on each side of this and on the upper surface a narrow strip of glass is cemented. The under surface of the slab is divided into three strips, A, E, B (fig. 105), of equal breadth, A and B being ground and E clear. In application A and B are moistened with water, or, better, with a mixture of glycerin and water. The slab will then, by capillary attraction, adhere firmly enough to the Microscope stage to retain any position which it may be required to take; at the same time a slight push-action is sufficient to move it.

* Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 425–7 (1 fig.).

The sections are laid on the upper surface in the ordinary way. In the case of a very large number of sections it may be preferable to dispense with the ground strips; but even then the capillary action will be found sufficient to answer the purpose.

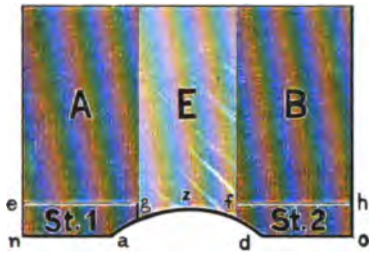

FIG. 105.

Reiff's Polariser.*—This instrument, which is described as a polariser without change of direction and without axis-displacement of the light-ray, is similar to Grimsehl's "Reflex polarisator," and is distinguished from it only in containing a much larger number of reflexions, but at the same time the light-intensity is strongly diminished. The instrument is designed in two models. In one an exchange of directions above and below may take place or may be avoided; the second model has one reflecting plane more than the first.

Koristka's Achromatic Oil-immersion Condenser.†—This has a numerical aperture of 1·30 and focal length 5·6 mm. It is applied to the Abbe fitting in the usual manner. It is essentially an objective of good central chromatic and spherical correction for homogeneous immersion. This property enables the luminous source to be projected in the plane of the preparation without the formation of coloured rings, and also permits of its use as an objective of weak magnification.

COX, ALVIN J.—**A New Comparator.**
Philippine Journ. Sci., ii. (1907) pp. 139–42 (3 figs.).

(4) Photomicrography.

Photomicrography in Colour with Autochromatic Plates of A. and L. Lumière.‡—Ch.-A. François-Franck appears to have met with very gratifying success. Even preparations requiring polarised light presented no special difficulty. Thus reproductions of crystals in Mont Blanc gneiss were faithfully obtained in all their colours. The time of exposure was not found capable of expression by any simple rule: experience only could determine it. In many cases 12 seconds would give

* Zeitschr. Physik. u. Chem. Unterr., xix. (1906) pp. 28–9 (2 figs.); see also Zeitschr. wiss. Mikrosk., xxiii. (1907) p. 497.
† Supplement to General Catalogue, N 12, Milan, April 1907.
‡ Comptes Rendus, cxliv. (1907) pp. 1340–1; see also C.R. Soc. Biol. de Paris, lxii. (1907) pp. 1099–1102.

excellent results, but with thick or obscure specimens 60 seconds might be required. When full solar light was not obtainable the investigators used arc-light.

SCHEFFER, W.—**Microscopical Researches on the Effect of the Persulphate and Ferricyanide Reducers, as also on the Re-developing of Bleached Negatives with Alcoholic Developers.**
Brit. Journ. Photog., liii. (1906) pp. 964–5 (9 figs.)

" " **Note on the Reversal of Solarised Negatives with Farmer's Reducer.** *Tom. cit.*, p. 1027 (2 figs.).

" " **Microscopical Researches on the Size and Distribution of Plate Grains.** *Op. cit.*, liv. (1907) pp. 116–20 (19 figs.).

" " **Microscopical Researches on the Plate Grain.**
Tom. cit., pp. 271–3 (7 figs.).

HANSEN, F. C. C.—**Einige Farbfilter, sowie einige histologische Färbungen für mikrophotographische Aufnahmen.**
[The author's experience leads him to recommend certain solutions.]
Zeitschr. wiss. Mikrosk., xxiii. (1907) pp. 410–14.

FRANÇOIS-FRANCK, CH.-A.—**Note générale sur les prises de vues instantanées microphotographiques (plaque fixe à pellicule) avec l'arc voltaïque.**
C.R. Soc. Biol. Paris, lxii. (1907) pp. 637–9.

(5) Microscopical Optics and Manipulation.

Ultramicroscopic Studies on certain Organic Colloids. Two Optic States of Organic Colloids.*—A. Meyer, under the above title, describes a series of experiments which show that organic colloids can be met with in two states optically different, viz. hydrogels, solidified or liquefied, relatively homogeneous; hydrosols, showing numerous granules. One state may be transformed into the other, and in the course of this transformation arise the solutions of "globulines" and of "albumine."

New Method of Determining Indices of Refraction.†—G. Cesaro employs for this purpose Wollaston's goniometer, without the use of any other special apparatus. Instead of deducing the index of refraction from observation of the angle of minimum deviation, the author previously determines on a certain deviation $2a$. He then determines by the goniometer the two positions, on alternate sides of the minimum deviation, in which the refracted ray undergoes this said deviation. The angle u, through which the prism must turn about its edge to pass from one position to the other, the angle ϕ of the prism, and the deviation $2a$, suffice for the calculation of the refractive index. The author gives a full account of the details and calculations.

Direct Visibility of Neutral Layers in Bodies supposed to contain them.‡—H. Siedentopf has succeeded in taking photographs of these under several conditions. One of his experiments was to bend a strip of plane-parallel glass, so that the middle part in cross-section was made semicircular, some of the original plane remaining as bilateral

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 42–4.
† Bull. Classe Sci. Acad. Roy. Belgique, 1907, pp. 135–162 (10 figs.).
‡ Pamphlet reprinted from the Zeit. des Osterr. Ingenieur- und Architekten-Vereines, lviii. (1906) No. 33, Vienna (10 pp.).

flanges. The shape was, therefore, something like a capital Omega. The convex part of the bend would conceivably be in extension and the concave part in compression. Between the two there might be expected a neutral layer. By means of a beam from an arc-light passed through lenses and two Nicols and projected upon a camera, a photograph was obtained which showed the neutral layer to lie about midway between the parallel surfaces and roughly parallel to them. He also obtained some remarkable figures in a similar examination of highly strained glass rod. His experiments were largely based upon the researches of O. Hönigsberg.

SIEDENTOPF, H.—**Über die physikalischen Principien der Sichtbarmachung ultramikroskopischer Teilchen.**
Berliner Klinischen Wochenschrift, 1904, No. 32; **and as a separate pamphlet, 7 pp.**

(6) Miscellaneous.

Textiles and Colours in the Ultramicroscope.*—J. Schneider and G. Kunzl have studied this subject for the purpose of discovering whether undyed and dyed textiles give characteristic spectra when viewed with the ultramicroscope. Their conclusions are as follows:—

1. The ultramicroscope is adapted for the testing of dyed as well as of stamped products of the textile industry, especially in the case of small patterns and mixed colours.
2. In the investigation those appearances which are characteristic of the dye are to be distinguished from those which correspond to the light not penetrating the colour fabrics.
3. The most trustworthy test of the dye is that with the spectral-ocular; it is also possible without the same to distinguish colours contained in the spectrum.
4. The most instructive image is that received from silk with the use of both polarising prisms.
5. Fabrics coloured according to various methods show various characteristic features in the ultramicroscope; distinction is chiefly found between colours obtained from insoluble and applied dye-stuffs and those obtained by direct dyeing.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Cultivation of a Bovine Piroplasma.‡—M. Miyajima adopted the method used by Rogers for cultivating the parasites of kala-azar. The blood containing the intracellular parasites is drawn from the jugular vein, and then quickly defibrinated under strict precautions so as to avoid bacterial contamination. It is then mixed with ordinary nutrient bouillon in proportions varying from 1 : 5 to 1 : 10, and placed asep-

* Zeitschr. wiss. Mikrosk., xxiii. (1907) pp. 393-409 (1 fig.).
† This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preserving fluids, &c.; (6) Miscellaneous.
‡ Philippine Journ. Sci., ii. (1907) pp. 83-91 (3 figs.)

tically in sterile test-tubes, which are thereafter maintained at a temperature of 20°–30° C. Motile forms begin to show themselves on the third day, and reach the maximum between the tenth and fourteenth day.

Asbestos Filter.* — O. Bujwid describes a method for filtering cloudy or turbid liquids. This consists in shaking up the liquid with a small quantity of asbestos and then filtering the whole, a completely clear liquid resulting. The author has employed this method not only for clearing broth and gelatin, but also for turbid liquids containing bacteria. It is, however, not suitable for filtering fluids used for the preparation of diphtheria toxins.

Collecting and Preserving Medusæ.† — E. T. Browne has used the following methods for some years. A small, flat hand-made net of bolting silk is useful for catching medusæ swimming at the surface. For towing nets the following sample is described. It has a circular mouth 17 inches in diameter, and the net is about 5 feet in length, gradually tapering down to 3½ inches in diameter, which is the diameter of the zinc can attached to the end of the net. The nets are made of bolting-silk; three nets form a series with 30, 50, and 70 threads respectively to the inch.

The speed of towing the net is important, and the speed is about right when the line can be comfortably held on one finger; this amounts to about a 3-lb. pull.

When the net is taken on board, the contents of the can should be poured into one or more glass vessels. The medusæ are then picked out and placed for half an hour or more in another vessel until they have recovered from the shock. If they lie heaped up at the bottom of the vessel they should be stirred up with a glass rod. The medusæ are quickly fixed and preserved by means of formalin (5–10 p.c.), but in order to do this successfully they must be kept in motion by stirring up with a glass rod while the formalin is slowly poured in. After a few hours they are transferred to 10 p.c. formalin, changed once before sealing up the bottle.

To obtain medusæ in a nice state of expansion, it is necessary to use an anæsthetic. Add about 3 c.cm. of 1 p.c. cocain for every 100 c.cm. of sea-water, stirring gently the while with a glass rod. If in from 10–15 minutes the tentacles are expanded, and do not contract when touched with a glass rod, no more cocain need be added, but if still active the process must be repeated. When the medusæ are anæsthetised, stir them round gently, and add the formalin, still stirring the while. Specimens must not be left too long in a cocain solution, as it has a softening action.

For Scyphomedusæ the addition of chromic acid is an advantage. The author uses one vol. 5 p.c. chromic acid and nine vol. 10 p.c. formalin. After soaking for several days in the chromic-formalin solution, to which a little strong formalin is added daily, the specimen is transferred to 10 p.c. formalin for permanent preservation.

* Centralbl. Bakt., 1te Abt. Orig., xliv. (1907) p. 191.
† Trans. Linn. Soc., Zool., x. (1906), pp. 163–80 (1 pl.)

(2) Preparing Objects.

Studying the Maturation and Fecundation of the Mammalian Egg.*—H. Lams and J. Doorme used white mice and guinea-pigs in their research. The ovaries, tubes, and uterine cornua, removed under an anæsthetic, were at once placed in some fixative, Flemming, Benda, and Hermann giving the best results. After hardening in up-graded alcohols, paraffin sections 2–5 μ were made with a Minot microtome. Most of the sections were stained with Heidenhain's hæmatoxylin. For demonstrating mitochrondria, Benda's method was adopted, the fixative being a modified Flemming (1 p.c. chromic acid 15 c.cm., 2 p.c. osmic acid 4 c.cm., 3 drops glacial acetic acid). After a long immersion in the fixative the pieces were transferred to a solution consisting of equal parts of pyroligneous acetic acid and chromic acid solution, then to 2 p.c. bichromate of potash. After washing and dehydrating, the pieces were imbedded in paraffin. The sections were mordanted for some hours in a 4 p.c. solution of iron-alum, and then in a solution of sulphalizarinate of soda. After this, they were hot-stained in freshly prepared crystal-violet solution. The sections were differentiated in 30 p.c. acetic acid, and after drying were passed through acetone, oil of bergamot, and xylol to balsam.

Mitochondria are also stainable by Benda's method.

(3) Cutting, including Imbedding and Microtomes.

New Method of Making Celloidin Serial Sections.†—W. Rubaschkin adopts the following procedure. He uses albumen-glycerin in the proportion of 2 : 1 for sticking the sections to the slide. While cutting, the sections are temporarily arranged on the back of the knife to the handle, and when a sufficient number has been made they are removed to the slide. It is important that every section should be quite flat and without creases; they are easily smoothed out by means of a brush and gentle pressure. When satisfactorily arranged on the slide they are covered with a mixture of equal parts of clove-oil and anilin-oil. When the sections are quite clear and transparent, which will be in from 3–5 minutes, the oil is poured off and the slide immersed in 90° alcohol to remove the remains of the oily mixture. The slides are then removed to 70° alcohol and kept there till required. If it be desired to remove the celloidin, the slides are placed in 96° or absolute alcohol, and afterwards in a mixture of equal parts of alcohol and ether. When the celloidin is dissolved out, the slides are passed through 96° to 70° alcohol, after which they can be submitted to any further treatment.

(4) Staining and Injecting.

New Injection Apparatus.‡—W. Lindemann, having experienced the desirability of an injection apparatus which should work at constant pressure, has designed that shown in fig. 106. A is an injection pipette which acts either as an air-chamber or as a reservoir for the injection

* Archiv Biologie, xxiii. (1907) pp. 259–365 (3 pls.).
† Anat. Anzeig., xxxi. (1907) pp. 30–1.
‡ Zeitschr. wiss. Mikrosk., xxiii. (1906) pp. 427–30 (1 fig.).

material. It is a cylindrical glass tube of about 120 c.cm. capacity with a three-way cock at the upper end and a simple cock at the lower. An open glass tube is laterally and internally melted on to it and almost reaches to its roof. Externally this tube bifurcates, one branch becoming a manometer 80 cm. long and the other connected by a thick-walled rubber tubing with a funnel B, held by a clamp on to the iron pillar of

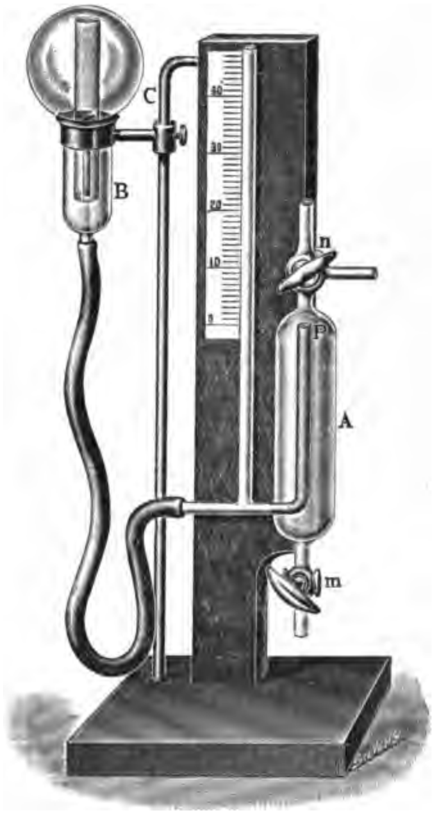

Fig. 106.

a vertical stand. The whole is first filled with quicksilver, which compresses the air in A to a pressure regulated by the mercury levels in the funnel and the manometer; these can be read off from the scale. In order to keep this pressure constant by slow ingress of mercury from the funnel, a spherical flask is inverted and fitted into the funnel neck. This flask is also filled with mercury, which can only flow when the level in the funnel is low enough to allow the admission of air into the neck of the flask. The action of the flask is improved by the open tube soldered into its neck, and the outflow of mercury takes place through a

small hole in the lower part of this tube. The impetus of the air-bubbles is useful in certain cases of injection. But if the oscillations caused by them are not required, then A should be only used as an air-reservoir, the elasticity of the air acting as a compensator. The cock *m* serves for drawing off the mercury which has flowed into A. The pressure attainable ranges from 0–500 mm. of mercury.

(5) Mounting, including Slides, Preservative Fluids, etc.

Mounting Media of High Refractive Index.*—H. van Heurck, who at various times since 1883 has introduced to the notice of Microscopists mounting media of high refractive index, makes a further communication on this subject. With regard to Styrax he finds that the commercial variety can be quickly purified by first baking to get rid of as much moisture as possible, and then dissolving in boiling absolute alcohol. After filtering, the liquid thus obtained is evaporated to dryness and the yellowish-brown mass dissolved in benzine. This solution should be filtered anew. The author mentions that L. van Itallie obtains a light-coloured styrax by treating the raw commercial article with petroleum ether. The dissolved portion is evaporated, and the extract thus obtained is of a quite light colour.

By dissolving equal parts by weight of piperine and styrax or liquid amber a medium with refractive index of 1·63 is obtained. This has remained perfectly unchanged for about five years. By mixing 6 parts of the foregoing with 1 part of piperine a still higher index is obtainable. This medium is liable to deposit crystals, but if re-melted and a little liquid amber added the crystals do not re-form.

If real benzoin of Siam be dissolved in chloroform it gives a medium with index about 1·60. It is yellowish, and sets quite hard.

By melting together in a porcelain capsule 3 parts of piperine and 2 parts of bromide of antimony, a medium with a refractive index about 1·70 is obtained. Too much heat should not be employed, as the mixture may become brown. The successful result is a yellowish substance which is very durable.

Monobromide of naphthaline and iodide of methyl have refractive indices respectively of 1·658 and 1·743. Both of these, while having excellent features as mounting media for diatoms, are subject to inconveniences which render them difficult for practical purposes.

The double iodide of mercury has a refractive index of 1·654, and though showing up the details of diatoms admirably, is not very convenient in practice. It is prepared by adding the red iodide of mercury to a saturated solution of potassium iodide until no more is taken up.

The arsenical medium of H. L. Smith, though most excellent, is liable to become opaque from the deposit of sulphur. The cause of this is due to insufficient boiling. If the heating be prolonged until all the bromide of arsenic has been driven off, the mounts will be found eventually to be perfectly stable. After the slide has cooled down, the coverslip should be ringed round with paraffin, and this afterwards varnished over.

The author opines that Canada balsam mounts are of no value, and

* Mém. Soc. Belg. Micr., xxviii. (1907) pp. 56–63.

that as liquid amber is so difficult to obtain, recourse must be had to styrax. The double iodide of mercury and potassium, which is miscible with water, is useful for rapid examination of valves or frustules, the structure of which is to be examined as soon as they are taken from water. It is a dangerous liquid, and care must be taken that it does not come in contact with objectives as the mounting of the lenses may be attacked. Smith's arsenical medium should be reserved for the examination of ultra-difficult details.

(6) Miscellaneous.

MARK, E. L.—**Electric Wax-cutter for Use in Reconstructions.** [Describes an ingenious machine for cutting out the wax plates, intended for the reconstruction of objects, by means of an electrically heated wire.]
Proc. Amer. Acad. Arts and Sci., xlii., 1907, pp. 629–36 (3 figs.)

Metallography, etc.

Evolution of Modern Tool Steel.*—H. C. H. Carpenter deals with some questions raised in F. W. Taylor's recent paper.† He considers that hardened steel is some form of combination of carbon with a solution of carbon in either β- or α-iron or both, and has an acicular microstructure. The best treatment of high-speed steels consists in heating to a very high temperature, cooling rapidly to about 815° C., then at a moderate speed to cold, and re-heating to about 620° C. The tool after this treatment is a mixture in which there is present some γ-iron, the remainder consisting of an almost structureless material, probably of an extremely fine and hard martensitic type. Chromium is an indispensable constituent of high-speed steel, and appears to bring about a condition of complete solution of the constituents. Carbon content may vary within wide limits. It is suggested that a cutting test with a tool maintained at a temperature over 900° C. would give valuable results.

Magnetic Behaviour of Certain Nickel Alloys.‡—B. V. Hill has determined the temperature of magnetic transformation of alloys of nickel, to test the applicability of van 't Hoff's law relating to the lowering of the freezing-point of a liquid by dissolved substances, to the lowering of the transformation-point of a magnetic metal by the addition of another metal. The transformation takes place over a wide temperature interval. The following results were obtained for the transformation temperatures of the nickel-copper alloys :—

Copper.	Temperature.	
p.c.	Hard.	Annealed.
0	355°C.	340°C.
4	310	295
8	280	265
20	155	140
40	−100	—

* Engineering, lxxxiii. (1907) pp. 569–71 and 633–4 (9 figs.).
† See this Journal, 1907, p. 251.
‡ Physical Review, xxiv. (1907) pp. 321–36.

The depression of the transformation point is proportional to the amount of the added metal both in the nickel-copper and nickel-tin alloys, but not in the alloys of nickel with silver. The latent heat of transformation of nickel was determined by an indirect method, a mean value of 4·48 being obtained. The author concludes from his own results and those obtained by other workers that there is no simple relation between the atomic weight of the added metal and the lowering of the transformation temperature of nickel.

Change of Structure in Iron and Steel.*—W. Campbell, discussing the equilibrium diagram of the iron-carbon system, takes the view that the same diagram may represent either the solidification of cementite with formation of a cementite-martensite eutectic or the solidification of graphite with the formation of a graphite-martensite eutectic. The author gives the results of some heat-treatment experiments on six high carbon-steels.† A general description of the structure of iron and steel is included, with some notes on the effect of heat-treatment.

Piping in Steel Ingots.‡—A. Obholzer gives his experience of the advantages resulting from the use of thermit to diminish piping.

Tantalum Steels.§—L. Guillet has examined 4 steels containing 0·09, 0·15, 0·60 and 1·05 p.c. tantalum, carbon 0·12–0·18 p.c. A ferro-tantalum made in the electric furnace was used in the preparation of the alloys. No special difficulty in melting or in mechanical treatment was experienced. The normal steels were found to be pearlitic. Tantalum appears to have a slight hardening effect. The influence of this element on microstructure and mechanical properties is small, and the author concludes that tantalum steels are of little practical interest.

Relations between the Diagram of Binary Alloys and their Malleability.||—L. Guillet states some general laws deduced from data available, dealing with each possible type of equilibrium diagram. The malleability of an alloy is a function of the malleability of each solid phase and the proportion of malleable to non-malleable phases present. An alloy consisting of a pure compound or a pure solid solution (corresponding to a maximum of the liquidus and solidifying at a constant temperature) is not malleable. A solid solution rich in a malleable metal is malleable. Two metals which form a continuous series of solid solutions are either both malleable or both non-malleable, and the alloys have the same characteristics.

Constitution of Alloys.¶—A. Portevin fully describes Tammann's method of thermal analysis, passing in review the numerous cases, corresponding to the different types of equilibrium curve met with in the study of alloys, for which the method has been worked out at the University of Göttingen. The principle of the method is as

* Journ. Franklin Inst., clxiii. (1907) pp. 407–34 (35 figs.).
† See this Journal, 1907, p. 253.
‡ Journ. Franklin. Inst., clxiv. (1907) pp. 1–11 (10 figs.).
§ Comptes Rendus, cxlv. (1907) pp. 327–9.
|| Op. cit., cxliv. (1907) pp. 1273–5.
¶ Rev. de Métallurgie, iv. (1907) pp. 797–813 (13 figs.).

follows. Given a univariant equilibrium occurring at a temperature t° between three phases of concentrations ϕ_1, ϕ_2, ϕ_3, owing to the formation or decomposition on cooling of the phase ϕ_3, according to the reversible and isothermal reaction

$$\phi_1 + \phi_2 \rightleftarrows \phi_3$$

an evolution of heat is produced on cooling the amount of which may be estimated by the length of the step at t° in the cooling curves. The heat evolution is at a maximum for the concentration ϕ_3 and nil for the concentrations ϕ_1 and ϕ_2. If now curves are plotted showing the variation of these heat evolutions as a function of the concentration, ϕ_1, ϕ_2 and ϕ_3 may be determined by extrapolation. The author emphasizes the extreme importance of the method, and the value of the data which have been obtained by its application to numerous series of alloys.

Alloys of Nickel and Lead.*—A. Portevin gives the equilibrium diagram obtained by the application of Tammann's analytical method to the cooling curves of twelve alloys. The diagram indicates that (1) from 0–0·07 p.c. nickel, lead first separates from the liquid, solidification of the eutectic occurs at 323° C.; (2) from 0·07–7 p.c. nickel, crystallisation of nickel takes place along a steep branch of the curve, and is followed by solidification of the eutectic as before; (3) from 7–60 p.c. nickel, the mixture, completely liquid above 1365° C., is composed of two non-miscible portions: nickel separates from the nickel-rich layer at 1365° C., the liquid remaining (7 p.c. nickel) solidifies as in (2); (4) from 60–100 p.c. nickel, a branch of the curve rising from 1365° C.–1484° C. indicates the separation of nickel from a homogeneous liquid. When the concentration of the liquid falls to 60 p.c. nickel at 1365° C. the subsequent changes are as in (3). No compounds or solid solutions are formed, the solid alloys containing more than 0·07 p.c. nickel are composed of nickel and the lead-nickel eutectic.

Ternary and Quaternary Vanadium Steels.†—L. Guillet gives an account of Pütz's researches on vanadium steels, comparing the results with those obtained by himself. A description of the author's latest work on nickel-vanadium steels follows, in which increasing amounts of vanadium were added to pearlitic nickel steels near the martensitic boundary. The vanadium appears slightly to increase the tendency towards the formation of martensite; it also raises progressively the maximum stress and elastic limit. To obtain the best properties it is necessary to maintain the carbon content low, the nickel as high as is consistent with a pearlitic structure. The industrially useful steels fall within the limits 0·1–0·3 p.c. carbon, 2–7 p.c. nickel, and 0·1–0·3 p.c. vanadium.

Boron Steels.‡—A more complete account is given by L. Guillet of his investigation of six boron steels.§ The ferro-boron used in the pre-

* Rev. de Métallurgie, iv. (1907) pp. 814–18 (5 figs.).
† Tom. cit., pp. 775–88.
‡ Tom. cit., pp. 784–96 (17 figs.). See also Journ. Iron and Steel Inst., lxxiv. (1907) pp. 207–18 (17 figs.).
§ See this Journal, 1907, p. 508.

paration of the steels contained 32 p.c. boron, and was made in the electric furnace from calcium borate. Boron raises the thermal critical points of steel. The special constituent (boro-carbide of iron) may be caused to disappear by heating above 850° C., followed by quenching, but with increase of boron-content the difficulty of thus dissolving the boro-carbide increases. The presence of this body causes brittleness, and is accordingly objectionable. It is only in the quenched state that these steels appear to be suitable for any industrial application. A boron content of 0·5 p.c. gives the most interesting results.

Copper Steels.*—P. Breuil has previously published results of his work on these alloys.† The present complete account contains much new matter. Four series were examined, containing carbon about 0·15, 0·35, 0·65, and 1·0 p.c., copper in each series increasing from 0·5–30 p.c. Ar 3 and Ar 2 are lowered by the presence of copper in soft steels. In medium carbon steel Ar 1 is lowered, but not below 550° C. The position of Ar 1 in hard steels is not affected. Tensile strength increases with copper content—copper thus has an effect comparable with that of nickel; resistance to shock is good. Copper steels are commercially serviceable up to about 4 p.c. copper; no segregation occurs below this limit. Free copper occurs in the steels containing more than 8 p.c. copper. Talc was used in place of alumina as the polishing powder for micro-specimens. More than 100 photomicrographs are given.

Cast Iron as Cast- and Heat-treated.‡—W. H. Hatfield has attempted to locate the regions of temperature in which the carbide of iron breaks up into iron and carbon. Test bars of a white iron containing 3·4 p.c. carbon (all combined), 1·1 p.c. silicon, were cast in sand, and were heated together in an annealing oven. One bar was cooled in air, and one quenched in water when the temperature had risen to (1) 780° C., (2) 820° C., (3) 860° C., (4) not higher than 900° C. and cooled extremely slowly (*a*) to 750° C., (*b*) to 650° C. As regards distribution of annealing carbon, the quenched bars differed little from the air-cooled bars. Sections from all the bars were microscopically examined. Annealing carbon first appeared in the bars cooled from 820°C., and increased progressively in the subsequently cooled specimens. The massive cementite appeared to decompose between 800° and 900° C., while the bulk of the pearlite disappeared during cooling from 750°–650° C., giving ferrite and temper carbon. From his experiments on influence of casting temperature, the author concludes that while great variation in strength is found between cast irons of the same composition as cast, there is no direct relation between strength and casting temperature.

Non-Metallic Impurities in Steel.§—By microscopical and chemical methods, E. F. Law has demonstrated the existence in steel of sulphide, silicate, and oxide of iron, sulphide and silicate of manganese. Sulphide of iron is rarely found in commercial steels, the sulphur existing

* Journ. Iron and Steel Inst., lxxiv. (1907) pp. 1–78 (16 figs., 10 pls.).
† See this Journal, 1906, pp. 516 and 740.
‡ Tom. cit., pp. 79–93 (23 figs.).
§ Tom. cit., pp. 94–105 (11 figs.).

as sulphide of manganese, which usually is comparatively harmless. The silicates have a decidedly injurious effect. Oxide occurs as minute black specks, visible in the polished section with a magnification of 1000 diameters. These specks are invariably found in steels which give blisters on pickling: this supports the view that the blisters are due to the presence of oxide. Oxygen was determined by passing hydrogen over heated drillings and weighing the water formed. The samples examined by the author were found to contain 0·02 to 0·06 p.c. oxygen. The presence of oxygen in steel appears to favour corrosion to a marked degree. The pitting of boiler plates and tubes is ascribed to oxide.

Relation between the Process of Manufacture and some of the Physical Properties of Steel.*—F. W. Harbord gives the results of a large number of tensile and other tests, bringing out the important differences in strength of steels having the same carbon content but differing in process of manufacture. For a given maximum stress a basic open hearth steel requires the most, and an acid bessemer the least carbon.

Ageing of Mild Steel.†—C. E. Stromeyer gives a large number of instances in which lapse of time appeared to have an effect on the physical properties of steel. Frequently this effect was a development of brittleness. The author carried out bending tests on strips sheared from plates, the time between shearing and testing being varied. Some of the test pieces were submitted to treatments such as annealing, maintaining at a low temperature, heating at 100° C. and at a blue heat. The results are conflicting, but appear to show that certain steels deteriorate gradually after local straining caused by shearing, or nicking with a chisel. In some cases the steels improve with the passage of time.

Carbon-tungsten Steels.‡—T. Swinden has prepared nine steels containing an approximately constant tungsten content (3 p.c.), carbon varying from 0·14 to 1·24 p.c., and has carried out mechanical tests, microscopical examination, and determination of critical ranges. Numerous curves were taken by the direct method to determine the effect of initial temperature on critical ranges. Among the author's conclusions are—

1. A definite compound, Fe_3W, is formed by melting the two elements together in certain proportions.

2. Maximum tensile stress is higher, and elastic ratio much higher than for carbon steels of the same carbon content.

3. Below a certain initial temperature (the "lowering temperature") which is higher as the carbon content is greater, the critical points are the same as for carbon steels. In steels below 0·35 p.c. carbon heating beyond this temperature lowers Ar 1 to a definite "low point" (570° C. for the 3 p.c. tungsten steels). With carbon 0·35 to 0·9 p.c. Ar 1 is first lowered. As the initial temperature is further raised, Ar 3, 2, is

* Journ. Iron and Steel Inst., lxxiii. (1907) pp. 181–99 (6 figs.).
† Tom. cit., pp. 200–260 (31 figs.).
‡ Tom. cit., pp. 291–327 (26 figs.).

displaced towards Ar 1. With the higher carbon steels Ar 3, 2, 1 is lowered as a whole by heating beyond the lowering temperature and produces a single low point. The eutectic composition is the same as for carbon steels.

Platinum Alloys.*—F. Doerinckel has determined the equilibrium diagrams for the binary alloys of platinum with copper, silver, gold, tin, and lead by thermal methods, confirming the results by microscopical examination. With gold and copper, platinum forms a continuous series of mixed crystals. With silver a similar series of mixed crystals is found from 0–48 p.c. platinum. With lead and tin a number of compounds are formed. Of the three lead-platinum compounds, the formula of one only, PtPb, has been established. Pt_3Sn and PtSn are indicated as the formulæ of two of the four platinum-tin compounds, while the other two are probably Pt_2Sn_3 existing in two allotropic modifications, and Pt_3Sn_8. The relationship of platinum to the definitely electropositive metals would appear to be more remote than to those of the middle part of the periodic system. All these platinum compounds except Pt Sn appear to decompose on melting, forming a liquid of definite concentration and another solid phase.

Ternary Alloys of Lead, Magnesium, and Tin.†—A. v. Vegesack devotes the first portion of this paper to a theoretical consideration of the conditions of equilibrium of a ternary system in which two binary compounds occur, but no ternary compounds and no ternary mixed crystals. The three components are assumed to be miscible in all proportions in the liquid state, and the compounds to be fusible without decomposition. The numerous types of equilibrium possible are separately considered in two main classes: (1) no mixed crystals are formed; (2) the two compounds are isomorphous. The author has determined the equilibrium diagram of the lead-magnesium-tin series by thermal analysis of the cooling curves of more than 100 alloys, which were also examined microscopically. The two compounds $SnMg_2$ and $PbMg_2$ which occur in this series form with each other two series of mixed crystals α and β. These, with the two compounds and the three pure metals, are the only solid phases. α has a limiting concentration (α_1) 22 p.c. Mg, 21 p.c. Sn, 57 p.c. Pb, by weight. With more $PbMg_2$ the reversible reaction

$$\text{mixed crystals } \alpha_1 + \text{melt} \rightleftarrows \text{mixed crystals } \beta_1$$

occurs at 570 C.

It is not possible to give here more than a general outline of this illuminating contribution to the study of ternary alloys.

Alloys of Antimony with Manganese, Chromium, Silicon, and Tin; of Bismuth with Chromium and Silicon; and of Manganese with Tin and Lead.‡—R. S. Williams has determined the equilibrium diagrams for each of these binary systems, and summarises the results in a table which is too lengthy to be reproduced here. 10 p.c. ferric

* Zeitschr. Anorg. Chem., liv. (1907) pp. 333–6 (23 figs.).
† Tom. cit., pp. 367–416 (38 figs.).
‡ Op. cit., lv. (1907) pp. 1–33 (34 figs.).

chloride solution, dilute nitric acid, and the vapour of concentrated nitric acid, were the etching reagents. The compounds are Sb_2Mn_3, $SbMn_2$, Sb_2Cr, SbCr, SbSn (?), $SnMn_4$, $SnMn_2$, SnMn (?). The magnetic properties of some of the alloys were studied.

Behaviour of Iron with Lead, Bismuth, Thallium, and Cadmium.* E. Isaac and G. Tammann show that solid iron is completely insoluble in these molten metals, and non-miscible in the liquid state with lead and bismuth, while the boiling points of cadmium and thallium are below the melting point of iron. No alloys could therefore be obtained.

Alloys of Iron with Platinum.†—E. Isaac and G. Tammann give the equilibrium diagram. At high temperatures the two metals form a continuous series of mixed crystals. At lower temperatures, this is transformed into two other series of mixed crystals containing respectively 0–50 p.c. and 60–100 p.c. platinum. The transformation temperature of iron (Ar 3) is lowered by addition of platinum. The analogy between these alloys and the nickel-iron alloys is indicated. Dilute nitric acid and hot aqua-regia were the etching reagents, one or the other being used according to platinum content.

Potential and Nature of Metallic Alloys.‡—N. Puschin has determined the potential curves of some binary alloys. The E.M.F. is that given by a cell made up of one pure metal, the alloy, and the aqueous solution of a salt of the metal. The typical curves proper to different types of binary series of alloys are described. The application of the method to the study of alloys is indicated.

BELL, J. M.—**The Composition of Solid Phases in Four-component Systems.** *Journ. Phys. Chem.*, xi. (1907) pp. 394–5.

BEAUMONT, W. W.—**Corrugation of Tramway Rails.** *Engineering*, lxxxiv. (1907) p. 256.

GUILLET, L.—**Constitution of Copper Alloys.**
[The author's conclusions regarding the existence of a brittle zone in each series of binary alloys of copper are illustrated by photomicrographs.]
Rev. Métallurgie, iv. (1907) pp. 622–7 (5 figs.).
See also this Journal, 1907, p. 508.

GUERTLER, W.—**Modern Metallography.** *Zentralbl. f. Eisen.*, ii. (1907) pp. 478–9.

HEATHCOTE, H. L.—**Passive Iron.** *Journ. Soc. Chem. Ind.*, xxvi. (1907) pp. 899–917 (28 figs.).

OBHOLZER, A.—**Avoidance of Pipe Formation.** *Stahl und Eisen*, xxvii. (1907) pp. 1117–21, 1155–60 (17 figs.).

VIGOUROUX, E.—**Nickel-tin Alloys.** *Comptes Rendus*, cxlv. (1907) pp. 246–8.

* Zeitschr. Anorg. Chem., lv. (1907) pp. 58–62 (2 figs.).
† Tom. cit., pp. 63–71 (7 figs.).
‡ Journ. Soc. Chem. Ind., xxvi. (1907) p. 826. See also J. Russ. Phys.-Chem. Ges., xxxix. (1907) pp. 13–54.

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Journal of the Royal Microscopical Society

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS

AND

A SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(Principally Invertebrata and Cryptogamia)

MICROSCOPY, &c.

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JOURNAL

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DECEMBER, 1907.

TRANSACTIONS OF THE SOCIETY.

XIV.—*Note on a New Prismatic Microscope Ocular.*

By A. A. C. Eliot Merlin.

(*Read October* 16, 1907.)

The writer has at various times been obliged to make prolonged observations with the Microscope in an upright position, and has practically found that it entails great fatigue to the eye, especially when examining rapidly moving infusoria under the highest powers. It occurred to him that a comfortable posture when perforce using the instrument upright could be easily secured by means of a properly designed prism, to be placed over the eye-lens of the ocular, and so constructed that the worker should view the image bent to 60°, exactly as if the Microscope were inclined at that most convenient observational angle.

On being applied to for assistance in this matter, Mr. E. M. Nelson most kindly computed a prism of the kind required, and of which a figure is subjoined. This prism has been constructed for the writer by Zeiss of Jena, and has proved most efficient and satisfactory in use. It has been adapted to the Zeiss ×12 long tube compensating ocular, but yields good results also with the ×18 and ×27 for the long tube, and with the ×4, ×8, ×12, and ×18 compensating eye-pieces for the short tube.

Applied to the × 12 ocular, it passes the full cone of the 12 mm. apochromatic objective of measured N.A. 0·7. This was proved by arranging the iris diaphragm of the substage condenser so that its edge should be just apparent at the back of the objective when viewed without the eye-piece, the prismatic ocular being then inserted and the Ramsden disk examined with a loup, when the periphery of the diaphragm remained visible at the edge of the

circle. It is thus certain that the prism will pass the full cone of any ordinary high or low power objective.

With the 24 mm. apochromat of N.A. 0·32, and a large axial illuminating cone, the minute spines on the membrane of the blow-fly's proboscis appeared jet black and remarkably clearly defined, the focus not requiring the slightest alteration when the ocular was employed with and without the prism. The fine quality of the image also appeared absolutely unimpaired by the addition of the prism.

With the 12 mm. apochromat and a full solid illuminating cone on an extremely sensitive object, the tube-length correction for thickness of cover-glass was found to be precisely identical for the same ocular when used alone or with the prism added, the

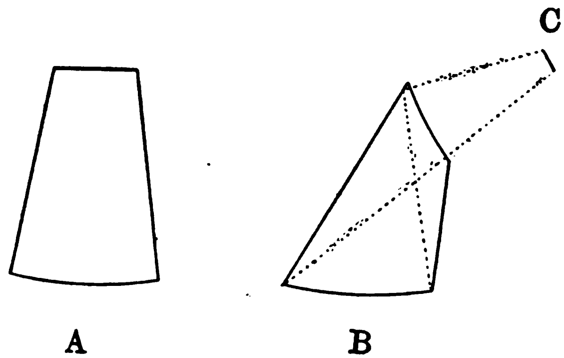

Fig. 107.

A. Back view of prism. B. Side view. C. Ramsden's disk.

The dotted lines show the paths of the marginal rays.

colour correction also proving most satisfactory when tested on the *N. lyra*.

The annexed figure (fig. 107) shows the form of the prism. The lower surface, that next the eye-lens of the ocular, is convex to allow the rays to enter the prism normally. The upper surface is concave in order that these rays may be discharged into the air without refraction. These curved surfaces form a meniscus lens, but by selecting suitable curvatures with respect to the path of the rays through the prism, the lens is made so long in focus that it has no effect upon the Microscope image.

Should a prism be required for use with only one particular eye-piece, it would be doubtless preferable to combine it with the eye-lens of the ocular, making the eye-lens and prism of one piece of glass by adjusting the lower surface B to the proper radius. But an appliance which can be utilised at need on a variety of

eye-pieces is more likely to commend itself to the practical working biologist.

The prism, when used in conjunction with the $\times 12$ long tube ocular and a number of high and low power objectives on delicate and sensitive objects, has been found to yield absolutely critical and brilliant images, in every way as perfect as can be obtained without it, while the eye-point is situated at a convenient distance from the emergent surface, so that it converts an upright Microscope into a most suitable instrument for prolonged observation in a comfortable posture, and renders work pleasant which has hitherto proved most trying and fatiguing, through the head being necessarily held down, and the eye applied to the ocular in a constrained position, which could hardly fail to injure such a sensitive organ; thus, students who have been heretofore forced by circumstances to do their work in such discomfort are greatly indebted to Mr. Nelson for having so ably computed this little contrivance, which will entirely remove their difficulties, without sacrificing the efficiency of the most perfect apochromatic optical combinations, and will impart to a non-inclinable laboratory instrument all the convenience of one provided with a pivoted stand.

It should, however, be noted that the new contrivance is not suitable or intended for drawing, as the prism erects, but does not transpose the object. For example, a letter F on the stage is seen with the usual eye-piece inverted thus Ⅎ, but with the prism added it appears as ꟻ. For visual observations, especially of small living monads, bacteria, etc., this will be found of no practical disadvantage, and it is only of importance when a drawing is required, for which purpose the prism should be removed.

XV.—*On Ghost Images seen in the Secondaries of Coscinodiscus Asteromphalus, with some Remarks on the Highest Useful Ratio of Magnifying Power to Aperture.*

By A. A. C. Eliot Merlin.

(*Read October* 16, 1907.)

Most critical workers are probably well acquainted with the beautifully defined ghost images of the substage condenser-stops afforded by the primaries of many diatoms, for those yielded by the perforations of the coarser forms may be well observed under quite moderate powers, the supporting arm, or arms, of the stop being also often sharply pictured. In the old days, distinct dotted resolution of the *P. angulatum* was frequently attained in this way with the central stops of Gillett's condenser, under poor objectives hardly capable of plainly rendering the structure with a central cone, what was thus seen being merely the tiny black stop images formed in the perforations, although it is needless to say that the proper demonstration of these images as clean, well-defined disks in such small holes as those in question requires careful manipulation and the best modern lenses.

Some time ago Mr. E. M. Nelson suggested that it would be interesting to ascertain the smallest perforation in which the condenser stop-image could be seen with the finest modern objectives and appliances; and it occurred to me to try the secondaries of *Coscinodiscus asteromphalus* under a picked Zeiss 3 mm. apochromat of measured N.A. 1·42, employed in conjunction with Powell's dry apochromatic substage condenser. With this arrangement it was found that perfectly well-defined jet black ghost images of the stop were distinguishable as sharp round disks in many of the cap perforations, it being necessary to use a ×40 ocular to attain sufficient magnification to exhibit them well, for with a ×12 eye-piece they appeared to be merely tiny black specks.

In order to measure the exact size of the perforations, the particular specimen of *C. asteromphalus* was photographed by sunlight from a heliostat, with the secondaries in black dot focus, the sun's image being sharply projected on the object with the full aperture of Powell's dry apochromatic condenser, the 3 mm. objective and an eye-piece being used so as to obtain a direct magnification of 3400 on the plate. The average diameter of the secondaries thus photographed was found to be 0·03 inch; this, divided by 3400, makes 0·000008826 inch. In order to

ascertain their true size, the antipoint correction for a working aperture of 0·9 must be added; this amounts to 0·00000324 inch, making the actual diameter of the holes $\frac{1}{83300}$ inch.

We thus find that the best modern optical combinations are capable of accurately picturing the minute image formed by a diatomic aperture $\frac{1}{83300}$ inch in diameter, the tiny disk visually appearing singularly well defined, although small even under a a power of 3200.

The *C. asteromphalus* is, to the critical microscopist, one of the most interesting and useful forms of all the Diatomaceæ. As a test object of the working quality of objectives of the highest numerical aperture yet constructed, it can hardly be surpassed, for any lens which will show the structure of the perforated caps brilliantly, with good contrast, and no trace of fog under a nearly full axial illuminating cone, must be well corrected and adjusted, and can be relied upon to afford trustworthy results when employed upon such objects as the smaller infusoria, bacteria, etc. It also serves to demonstrate the difference which a slight change in tube-length or movement of the correctional collar of a good objective will effect towards the making or marring of the image, and will speedily convince the tyro that the old-fashioned rough-and-ready plan of setting the collar about half way between "covered" and "uncovered" on a fixed tube-length could only lead to the production of faulty pictures devoid of detail. Owing to this cause there can be little doubt that much of the work done and recorded by biologists in the past on objects such as the smaller infusoria, monads, bacteria, and other minute organisms requiring large aperture skilfully utilised to reveal their proper forms and characteristics, will require revision by future observers. The demonstration of these minute creatures taxes the powers of the best modern optical appliances to the utmost, yet how many of the recognised "authorities" on their functions, appearance, and structure, would be regarded as experts in any question involving critical microscopical manipulation? The typical bacteriologist may be quoted as an example. He will choose and belaud a lens and optical arrangement which will show the greatest number of bacilli which happen to be lying haphazard throughout a large field of view all equally distinctly in focus at the same moment. The advantage of a lens which will only effect this is not very evident, for, as a rule, no particularly important object is attained in being able to see a number of separate forms distributed over a large area all exactly on one focal plane, and this is fortunate, for it will be found in practice that lenses of the very highest perfection, when their full aperture is utilised, do not yield nearly such flat fields as many objectives of inferior resolving power. The scientific investigator, in studying the features of a minute organism, may be supposed to require the lens and manipulative methods which will reveal its form and ultimate structure most

perfectly, irrespective of other similar objects which may be contained in the field of view, and which can, if necessary, be easily focused and scrutinised in turn.

It is obvious that the effective employment of the beautiful objectives now obtainable is of vital importance to all those engaged in original microscopical research if their results are to be of permanent value, and it is, therefore, hoped that the present communication may prove of interest to inexperienced workers who do not necessarily concern themselves with diatomic structure.

We all know that with an objective of N.A. 1·4, the practical visual resolving limit for lines ruled on glass does not exceed about 120,000 lines to the inch when a screen and nearly full solid illuminating cone are employed, Grayson's band containing this number of lines having been actually thus seen faintly but completely resolved under a 3 mm. apochromat of N.A. 1·42. Now because a power of about 1000 diameters may be sufficient to just show such lines when it is already known that they are there, and one is sure that the resolution is complete, it has been maintained that anything over a $\times 12$ eye-piece used in conjunction with a $\frac{1}{8}$-in. objective is merely useless empty magnification. Against this theoretical idea we must place the practice of the old leading microscopists, who effected most of their original discoveries by means of a much higher ratio of magnifying power to aperture. The theorist, too, is so accustomed to base all his opinions on the behaviour of ruled gratings, the true nature of which is exactly known to him, that he is apt to overlook the fact that the minute translucent organisms whose structure the biologist is concerned to ascertain, are not built up of a series of parallel lines or regularly distributed points, it being one thing to differentiate the several unknown components of such an object, and quite another to just perceive something already known to exist. Thus it has been most truly affirmed that when once a discovery has been made with a high power, a much lower one will usually be found sufficient to demonstrate it.

The general use of high magnifications may not be particularly popular or desirable from the professional optician's point of view, for imperfections in objectives which in ordinary circumstances may not be obtrusive, and thus invisible to the tyro, are rendered conspicuous so soon as the images are greatly enlarged by the ocular, especially as a very large illuminating cone will then be found necessary in order to secure comfort in observation and to avoid "entoptic" effects. This, together with the great magnification, strains the capacity of the lens to the utmost, and as a matter of fact many high priced objectives fail utterly under the trial. On the other hand many cheap semi-apochromats perform remarkably well under these hard conditions, and some few *accidentally* perfect combinations (apochromatic, semi-apochromatic, and even achromatic) will be found to withstand the ordeal in a surprising

manner; for it is undoubtedly true that certain exceptional high-power lenses will allow almost their full aperture to be utilised with axial illumination without exhibiting fog or pale and defective images. Unfortunately such objectives are extremely rare: they "happen" and cannot yet be produced at will.

Regarding this question of the real utility of employing very deep eye-pieces in certain cases with objectives of fairly high optical index, I may mention that a non-microscopical friend, on being shown some well stained bacteria under a Zeiss apochromatic $\frac{1}{8}$ in. of N.A. 1·42, a Powell compensated 40 ocular, and the full illuminating cone of the dry apochromatic condenser, without knowing or understanding anything of the optical arrangement, remarked on the clearness and distinctness of the forms and the restful quality of the green light (Gifford's screen) to the eye. On changing to the $\times 12$ eye-piece my friend at once protested that he could not see nearly so well or comfortably. One so often hears that anything over a $\times 12$ ocular is superfluous, that I had come to regard my own predilection for high eye-piecing as a personal idiosyncrasy, and of course it is easy to understand that mere amplification of image without sufficient resolving power to justify it is useless, but in spite of the generally prevailing opinion to the contrary, personally I have found that on many delicate objects with the majority of the picked objectives of modern construction in my collection, a $\times 40$ ocular gives the best possible view for the recognition and detection of previously unknown detail, when the corrections are perfect and large illuminating cones are employed. I have fully convinced myself that some well stained bacteria, the endoplasm of which clearly exhibits definite structural features with the $\frac{1}{8}$ in. apo. and $\times 40$ eye-piece, only show the barest indications of the existence of such internal structure with the same objective and $\times 12$ ocular, even when you know that the structure exists. The $\times 24$ and $\times 27$ oculars have proved more satisfactory, and would probably be quite sufficient for the examination of any already well known object.

The following two instances of the practical utility of deep eye-pieces may prove interesting:—

1. With a very good recent Powell achromatic 1 in. of N.A. 0·28 and solid axial illuminating cone of N.A. 0·22, the flagella of cholera bacilli stained by Löffler's method can be quite clearly and easily demonstrated with the $\times 40$ eye-piece. They are still easy, but not so conspicuous or well displayed with the $\times 24$ ocular, while with the $\times 12$ eye-piece they are practically invisible, and the bacilli themselves appear little more than mere dots. The objective, in this case, although a very fine one, is only a semi-apochromat and possessed of no excessive aperture, yet even with it the $\times 12$ ocular fails to reveal certain known features which can be most distinctly seen when higher eye-pieces are applied.

2. A large *Podura* scale possessing very clearly marked struc-

ture, of the well known kind, when examined with a Zeiss 24 mm. (1 in.) apochromat of N.A. 0·32, axial illuminating cone of N.A. 0·27 and ×12 ocular, to my eye practically only presented a very beautiful and well contrasted wavy watered silk appearance, while with the deeper eye-pieces the "exclamation" markings appeared distinctly separated and their shape completely and well defined, even the delicate sharply pointed ends being beautifully rendered with the ×40 ocular, and the image of the scale thus magnified to 400 diameters appeared sharp and critical, without any signs of undue strain on the defining qualities of the objective.

Of course in both the above examples all the points mentioned were in reality as fully resolved in the images afforded by the low as in those obtained with the high eye-pieces, only in the former instance the observer's eye proved incapable of grasping the minute details owing to insufficient magnification. With such a result on objects the structure of which was perfectly well known and familiar, the necessity of judiciously employing sufficient enlargement when engaged in original research need hardly be further insisted upon. The precise ratio of magnification to aperture advisable will, however, undoubtedly depend on personal equation, the nature of the object and the perfection of the objective and adjustments. It is therefore impossible to lay down a hard-and-fast rule on such a subject.

The ×40 eye-piece referred to above was made for me by Messrs. Powell and Lealand in 1901. It is compensated, but only moderately, the over-correction being much less than in the Zeiss oculars. In practice it has been found to work remarkably well, not only with apochromats of all powers, but also with many old achromatic objectives. For instance, I possess a Powell ½ in., made in 1850, of measured N.A. 0·385. This lens, probably one of the very finest old objectives ever made, when used with Gifford's F-line screen, will stand the ×40 eye-piece and a full solid illuminating cone without breaking down, and when thus arranged exhibits a brilliant, well contrasted picture of the minute spines on the membrane of the blow-fly's proboscis. With the screen and a solid 0·35 N.A. cone it will completely and cleanly resolve Grayson's 30,000 band. The image of this is of course faint, but by no means excessively so, and the performance of the objective is astonishing when we consider that a Grayson's 30,000 band is very nearly the practical working limit for a good modern apochromat of similar aperture: indeed it is noted in my memoranda as *extremely* difficult with a fine Zeiss' 16 mm. apochromat (really a ½ in.) of N.A. 0·35, an F-line screen and full solid illuminating cone. The glass of the old lens is to-day as clear and good as when it first left the workshop, and it is gratifying to know that an objective of such high perfection, even judged by modern standards, was constructed over half a century ago by the famous London firm.

XVI.—*Systematic Exposure with Transmitted Light in Photomicrography.*

By Alfred Letherby.

(*Read October* 16, 1907.)

When the Microscope has been set up and the image focused on the screen of the camera, a critical moment has arrived. The resulting negative, be it good, indifferent, or useless, will be dependent upon the exposure given. In deciding what this shall be, the operator is influenced by three governing factors:—

1. The intensity of the illumination.
2. The nature, colour, and density of the object.
3. The speed of the plate.

Watkins' speed card, or Welcome's exposure tables, provide a sufficient guide for the last, but the first and second have to be obtained from trial exposures under identical conditions; or at the best be an approximate estimate based on the appearance of the image on the screen.

If the operator is in the habit of working only on these limited lines, his method cannot be regarded as a satisfactory one, and it is either always necessary for him to set up his apparatus on the lines of former work, or court failure by a possibly mistaken calculation.

All photomicrographers will readily admit, it is desirable to be able to set up the object with such lenses, with such intensity of light, and with such magnification, as is most suited to display the object at its best, without first referring to former attempts, and to expose, without estimating by appearance the brilliancy, or want of brilliancy, of the image on the screen.

In order to achieve this, the appended table has been devised, and although it does not pretend to mathematical accuracy, it will be found on trial to fulfil the condition for all practical purposes.

The table itself cannot be used as it is intended, without a few satisfactory trial exposures, for the purpose of discovering one of the factors involved in its use. These must be made by each operator, and this is absolutely necessary, as no two individuals are likely to have identical factors for the production of the photograph.

The factor with the widest difference would probably be the light, and the next widest the focus of the condenser. Now it is evident no two operators will have command of the same illu-

minant: even two paraffin lamps, each with half an inch wick, may be so used as to give different degrees of intensity of illumination. But each individual would know how to repeat what he regarded as a suitable light. This light, which may be called the standard light (it does not matter what the light is, so that it can be reproduced again at will), is the foundation of the method to be employed.

In order to explain the use of the table, it must be pointed out that in addition to a satisfactory trial exposure for each kind of subject, there are four other factors controlling the exposure :—

1. The illuminant used should be so arranged with the trial exposure that it can be repeated at will.

2. The aplanatic cone of light passed by the circular aperture of the stop used beneath the substage condenser to regulate the light for contrast, definition, and resolution, must be known by its N.A. value.

3. The diametrical magnification on the focusing screen has to be ascertained.

4. The speed value of the plate.

5. The nature of the subject allowed for, and a standard trial exposure for each class of subject obtained under the above four conditions. If a screen or light-filter be used, this does not create a new factor, but simply modifies number one, the light with the screen or filter becoming the standard light.

Now it may be well to call attention to the omission of any reference to the tube-length of the stand, the objective, the ocular, or the camera extension. For purposes of exposure they are only regarded as amplifiers, and as such are considered when the magnification of the image is calculated. In practice the objective governs the N.A. of the stop to be used beneath the substage condenser. When this stop or aperture has been selected as the most suitable for the purpose, the light passed by the condenser is limited by it, so that as factors, except as amplifiers regulating the diametrical magnification of the subject to be photographed, the objective and ocular, the tube and camera extension, call for no separate consideration.

It is of the first importance that the N.A. value of the circular stops or apertures used with the substage condenser, or the different openings of the iris diaphragm, should be ascertained and marked for each condenser, and again for using with any portion of that condenser, if it is the desire of the operator to use it with the top lens removed.

It must not be understood that an ascertained exposure with a particular stop and condenser will apply to a stop of the same value with a condenser of a different focus. This by no means follows. But it would probably be correct with another condenser of the same focus, if the diameter of the back lens were the same.

It may afford some assistance if it is shown how three condensers with which the same fitting and stops are used are tabulated. These stops or apertures are numbered,* and against each stop is recorded its ascertained N.A. value with each condenser.

Powell and Lealand Oil Immersion Condenser N.A. 1·4.

			Top lens removed.		
Stop 6 used dry	N.A.	0·8	Stop 5 used dry	N.A.	0·4
„ 7 „	„	0·65	„ 6 „	„	0·3
„ 8 „	„	0·55	„ 7 „	„	0·25
„ 9 „	„	0·5	„ 8 „	„	0·2
„ 10 „	„	0·4	„ 9 „	„	0·15
„ 11 „	„	0·3	„ 10 „	„	0·12
„ 5 used with oil imm.	„	0·9			

Powell and Lealand Apochromatic Condenser N.A. 0·98.

Stop 10 used dry	N.A.	0·25
„ 9 „	„	0·3
„ 8 „	„	0·4
„ 7 „	„	0·47
„ 6 „	„	0·55
„ 5 „	„	0·65
„ 4 „	„	0·85
„ 3 „	„	0·95

Beck Oil Imm. Condenser N.A. 1·4.

Stop 3 used with oil	N.A.	1·25
„ 4 „	„	0·9
As water imm. with full aplanatic aperture	„	1·1

If the table is consulted, it is seen to be composed of columns of figures. The first column represents the aperture used to limit the light passing through the substage condenser. The other columns show what magnifications of the object to be photographed can be used with the same exposure, but each different magnification in the column needing the aplanatic aperture or stop in a line with it, shown in the first column. At the top of each column is the relative time of exposure for all the figures in that column as compared with the time of exposure needed by the magnifications in all the other columns.

Note that the fifth column of figures under time 1, commences with $\times 400$ on a line with N.A. 1·0, and terminates with $\times 20$ on a line with N.A. 0·05, and each intermediate $\times$ has its corresponding N.A. Any of the figures in the column used with the N.A. on the same line (or corresponding aperture) requires the same exposure.

The application of the table will be more clearly understood, and the principles best and most easily explained, by giving two or three practical examples.

Set up the standard light, which may be of any kind provided it can be repeated at will, then obtain the diametrical magnification of the object to be photographed in the usual way,

* Not Powell and Lealand's numbers.

To extend the table double the figures of any column and multiply the exposure time by 4.

Times of Exposure	1/16	1/8	1/4	1/2	1	1½	2	3	4	5	6	7	8	12	16	20	24	28	32
N.A.	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
1·0	100	142	200	285	400	490	570	695	800	900	980	1060	1140	1390	1600	1800	1960	2120	2280
·95	95	135	190	270	380	475	550	665	760	885	950	1010	1100	1330	1520	1710	1900	2020	2200
·90	90	127	180	251	360	437	510	630	720	810	875	954	1020	1260	1440	1620	1750	1910	2040
·85	85	120	170	240	340	425	480	595	680	765	850	900	960	1190	1360	1530	1700	1800	1920
·80	80	112	160	225	320	390	450	560	640	720	780	848	900	1120	1280	1440	1560	1700	1800
·75	75	105	150	210	300	375	420	525	600	675	750	795	840	1050	1200	1350	1500	1600	1680
·70	70	98	140	197	280	344	395	490	560	630	690	742	790	980	1120	1260	1380	1500	1580
·65	65	92	130	185	260	325	370	455	520	585	650	680	740	910	1040	1170	1300	1350	1480
·60	60	85	120	170	240	290	340	420	480	540	580	636	680	840	960	1080	1160	1275	1360
·55	55	80	110	160	220	275	320	385	440	495	550	583	640	770	880	990	1100	1170	1280
·50	50	71	100	142	200	245	283	347	400	450	490	530	570	695	800	900	980	1060	1140
·45	45	65	90	130	180	225	260	315	360	405	450	477	520	630	720	810	900	950	1040
·40	40	56	80	112	160	192	226	280	320	360	385	424	450	560	640	720	770	850	900
·35	35	50	70	100	140	175	200	245	280	315	350	370	400	490	560	630	700	750	800
·30	30	42	60	85	120	146	170	210	240	270	290	318	340	420	480	540	580	640	680
·25	25	35	50	70	100	125	140	185	200	225	250	265	280	370	400	450	500	530	560
·20	20	27	40	55	80	99	111	140	160	180	196	212	220	280	320	360	400	425	440
·15	15	22	30	44	60	75	88	105	120	135	150	160	176	210	240	270	300	320	350
·10	10	14	20	28	40	49	57	70	80	90	98	106	115	140	160	180	200	212	230
·05	5	7	10	15	20	25	30	35	40	45	50	55	65	70	80	90	100	110	130

Value of substage condenser diaphragm or aperture stops.

Diametrical magnification of object to be photographed.

and the plate used must be of known speed in order to make the needful calculation. The subject must also be allowed for in order to get the time value of the trial exposure.

Example 1.—Suppose the object is a diatom mounted in styrax. It is placed under a ¼ in. objective ×40, with a tube extension of 10 in., and a ×5 ocular. The camera extension is 10 in. We have now an image ×200. An aperture stop beneath the condenser previously ascertained to have a light value of N.A. 0·50 is placed in the usual position. Now a trial exposure, say with a circular wick paraffin lamp and bullseye 10 in. from the mirror, is found to give, on a medium ortho plate, a satisfactory result with three minutes' exposure. This now becomes a standard time with the same light and plate and an object of similar colour and density. The magnification and stop beneath the condenser, the objective and the eye-piece, the tube-length and the camera extension may all vary from that used in securing this trial exposure, but from it the time needed for any other exposure with the aid of the table can be at once ascertained, provided the conditions and factors before referred to be conformed with.

Example 2.—Now suppose the diatom is placed under a $\frac{1}{12}$-in. objective and the N.A. value of the aperture used with the sub-stage condenser is N.A. 1·0, and the amplification produced by objective, ocular and camera extension is ×400, the exposure with the same light, plate, and condenser is still 3 minutes.

Example 3.—Now use a more powerful ocular, and let the camera extension be greater so that the amplification becomes ×2000: we then find from the table that the ×2000 with N.A. 1·0 requires 24 times more exposure than column marked time 1, that is, 72 minutes. Of course, the original exposure with a more powerful light might only require 1 second instead of 3 minutes; in that case the time would be 24 seconds instead of 72 minutes.

Example 4.—The camera and Microscope have been set up again with diatoms in styrax as before, and it is desired to photograph in order to obtain depth of focus rather than extreme resolution. The measurement shows the magnificatiou to be ×200. The N.A. value of the aperture used with the condenser is 0·25. A reference to the table shows that four times the trial exposure is needed, that is, 12 minutes.

For oblique light the trial exposure would probably serve also, if circular apertures were used in the periphery of the condenser and the light derived from a large solid cone, and provided the whole of the light value of such aperture were passed by the objective. Thus a stop having, if used in the centre of the condenser, a value of N.A. 0·25, or N.A. 0·40, might be used in the periphery of a condenser capable of giving an aplanatic cone of N.A. 1·3. The table for aperture value of N.A. 0·4 only provides for a magnification of ×900, but it can be extended in every direction to meet the needs of any emergency.

XVII.—*A New Semi-apochromatic* $\frac{1}{6}$.

By Edward M. Nelson.

(*Read October* 16, 1907.)

During the recess a new objective, viz. a $\frac{1}{6}$ of N.A. 0·74, computed by Mr. Conrady, has been brought out by Messrs. Watson and Sons. The novelty of its construction gives it the altogether abnormal working distance of 1 mm., an attribute that will render this objective in many ways useful to biologists, medical men, metallurgists, etc.

Measurements show that its power and aperture are as stated. Its performance upon the usual test objects is exceptionally good; the lenses are very well put together, and exhibit no signs of excentricity. With the large W.A. of 0·65, and F-line screen, Grayson's 60,000 band was resolved; this agrees with the table of limits,* where 60,300 is the limit given for N.A. 0·75. Sections

Fig. 108.

of animal and vegetable tissues, and entomological details were brilliantly shown. The images of diatoms were particularly bright and clear, those of *Angulatum*, *Formosum*, and *Navicula rhomboides*, were very sharp. Few lenses (apart from apochromats) have shown as well as this new $\frac{1}{6}$ a balsam-mounted coarse *Formosum*, the most severe test to which a dry lens such as this can be subjected.

Bacteria (not that they are of much service as tests for microscopical lenses,† but as several Fellows of this Society belong to the medical profession, some among them might like to know the

* See this Journal, 1906, p. 529.

† Obviously it is impossible to form any judgment of the colour corrections of objective from the inspection of a purple- or blue-stained bacterium. It would seem that the only test that can be made with bacteria is the relatively unimportant one of flatness of field, which is done by comparing the sharpness of the image of a bacterium at the edge with one in the centre of the field. If an object at the edge of the field is out of focus when the centre is in precise focus, and

kind of image this lens gives of bacteria) were next examined, and the flagella of the tubercle bacillus could be seen without any special difficulty.

Now with regard to its working distance, this was not directly measured, but when the slide upon the stage was turned upside down, it was found that the lens would just focus the object through the slip. The thickness of the slip was then measured by a screw micrometer as being 0·064 in.; this divided by the refractive index, say 1·52, is 0·042, or $\frac{1}{24}$ in. This lens is normally corrected for an 8-in. tube, which is very handy, as it suits either a long or short body.

One more point before dismissing this subject. The measured sensibility for the tube-length correction of this lens is just about half that of modern semi-apochromatic sixths—a property which will, of course, prove very acceptable to a biologist, as his mind will be to a great extent relieved from anxiety and strain concerning a correction about which his ideas are in general hazy and undefined. But while it is unimportant to a microscopist, who can in a few seconds deftly bring his objective into best adjustment, it will nevertheless be the subject of considerable interest to him, because first-rate objectives seldom possess this useful property of insensibility to tube-length adjustment. Some few examples of fine old objectives held this quality in a marked degree, but most modern semi-apochromats require the tube-length to be closely watched if fine results are to be obtained.

The manifest usefulness of a lens of this description is my excuse for bringing it to the notice of the Society.

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if this object will become sharp by re-adjustment of focus, then the fault is curvature of image; but if it will not become sharp upon focal re-adjustment, the error arises from focal lines. Curvature of image is quite an unimportant error in a Microscope objective, because all critical observations should be made in the central portion of the field, the rest of the field being used merely as a finder. If it is necessary to view large masses of an object, a lower power should be used. Sharp central definition is not always compatible with flatness of field, and this sharp central definition should never be sacrificed for what, at best, is only of small importance.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Statistical Study of Sex-cells.‡—B. M. Allen has made a study of this kind on embryos of *Chrysemys marginata*. Some of the points elucidated may be noticed. The total numbers of sex-cells were found to be similar in the early and in the later stages, proving that there is no cell-division during these periods. The sizes of the embryos varied from 2·8 mm. to 8 mm. The first clear indications of the division of the sex-cells are found in an embryo 10 mm. long, and specimens some stages later than this show no division. It thus appears that the stage at which the sex-cells begin to multiply varies within pretty wide limits. This result agrees with the conclusions of Eigenmann and Beard. Beard's conception of a specific number of sex-cells, expressed by the formula $2^n - 1$, during these early stages is not borne out by the facts observed in *Chrysemys*, in which the number ranges from 302 to 1744. As to the migration of the sex-cells, it is noted that upon an average 47·7 p.c. reach the sex-glands, while the remainder come to rest in the alimentary tract, the mesentery, and the region between the root of the mesentery, the aorta, and the mesonephros. An interesting point is that in the case of double monsters arising from the same egg, each of the embryos has a normal number of sex-cells.

Inheritance of Coat-pigments and Coat-patterns in Rats and Guinea-pigs.§—H. MacCurdy and W. E. Castle state that the results of selection brought to bear upon the coat-pattern are seemingly very

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Anat. Anzeig., xxx. (1907) pp. 391–9 (5 figs.).

§ Carnegie Inst. of Washington, Publication No. 70 (1907) 50 pp.

different in rats and in guinea-pigs, yet a careful analysis of the facts shows the results to be not so dissimilar in the two cases as they at first sight appear. In both types the average extent of the pigmented areas can be increased or decreased at will by selection. The pigmented areas vary in extent continuously, and from these variations permanent modifications of the pigmentation can be secured. In guinea-pigs the authors attempted by selection to restrict the number of the pigmented areas; this was found to be impossible except as it occurred incidentally to reduction in the total amount of pigmentation. The regression occurred in number of pigmented areas, not, so far as known, in the total amount of pigmentation. Such regression occurred, however, where extreme variates were selected, e.g. in selecting black-eyed white guinea-pigs. Almost invariably such animals have borne more pigment than did their parents. The authors are inclined, however, to qualify de Vries' opinion that the effects of selection are not permanent, and consider the question still an open one. They incline to think selection is a most important factor, not only in the isolation of discontinuous variations but also in their production. A sharp line of distinction cannot be drawn between continuous and discontinuous variations. The hooded and Irish coat-patterns of rats are recognised discontinuous variations, alternative in inheritance, yet the authors had a lot of hooded rats (Lot M) undoubtedly intermediate between the two types. The coat-patterns of fancy rats, though discontinuous as they ordinarily occur, can be transformed into continuous variations. It is impossible to make a sharp distinction either here or between blending and alternative inheritance, and it is consequently "fallacious to assign all evolutionary progress to one sort of variation or to one sort of inheritance."

Determinate Variation.*—Vernon L. Kellogg, in an interesting paper, discusses the case of the "Californian flower-beetle" *Diabrotica soror*, which in the neighbourhood of Stanford University is "changing its spots." Statistics are adduced showing that in this region, but neither at Santa Rosa which is sixty miles to the north, nor at San José twenty miles south, *D. soror* has changed from a form whose elytra have twelve black spots on a green ground to one of eight spots free and two irregular transverse blotches in place of the middle four spots. An analysis of the case has led the author to conclude that the change is not an ontogenetic one, nor is it to be attributed to natural selection. The variations are of the small continuous type. The author concludes with the question: "Is there determinate variation?" Or in other words, is there progressive variation of a cumulative character—"determinate or orthogenetic"—which is independent of or antecedent to selection?

Development of Sympathetic Nervous System in Mammals.†—A. Kohn has investigated this subject in the rabbit. The cells of the primordium are neither directly separated off, nor do they migrate from the spinal ganglia. They arise from the ramus ventralis of the spinal nerve. Embryonal neurocytes deviate from the course of the mixed

* Science, xxiv. (1906) pp. 621–8.

† Arch. Mikr. Anat., lxx. (1907) pp. 266–317 (3 pls. and 3 figs.).

nerve in a median direction. By division, they yield a syncytial cellular strand, which extends from the spinal nerve towards the aorta, and in this way a primary cellular ramus communicans arises. This divides up into a greater number of columnar cell-masses, which are connected by cell processes with each other. These cell-masses, originating from the neurocytes of the spinal nerves, form the primordium of the sympathetic sheath. Embryonal neurocytes may take a share in the formation of peripheral spinal and sympathetic nerve-fibres, in the development of peripheral ganglion-cells, in the regeneration of peripheral nerve-fibres, and in the pathological re-formation of ganglion-cells.

Development of the Trachinidæ.* — J. Boeke, following up an earlier account of the eggs of the two species of *Trachinus*, *T. vipera* and *T. draco*, inhabiting the North Sea, describes the larval and post-larval stages of these two forms, of which he has been able to procure an unbroken series. The two species differ greatly even in the egg, and *T. draco*, the Greater Weevil, may be known from the Lesser in the larval stages by the relatively greater size of the head and the upturned mouth. Spines are developed early in both species, and the adult colours begin to appear when the fish reach a length of 16–17 mm.

Parturition of White Rat.†—E. Brumpt gives an account of this process. The "presentation" is variable, it may be "breech" or head. The umbilical cord does not break spontaneously, and if it breaks accidentally it is at some distance from the umbilicus. Certain fœtuses are expelled along with the placenta and their annexes. In others the cord breaks, or is broken by the mother, and the birth is a separate operation. In one case where the number of young was 10, 6 were in the right uterus and 4 in the left. They were expelled irregularly; the right horn probably held fœtuses 1, 3, 5, 8, 9, 10, and the left 2, 4, 6, and 7.

Structure and Development of Sperms in Rana.‡—Ivar Broman gives a very detailed account of the structure of the mature sperms in several species, and traces the development in *R. fusca*. In one point the course of development in *R. fusca* deviates from that of all others investigated whose spermatids possess a centriole ring which has arisen in the interior of the cell. The centriole ring which has arisen from the distal centriole in this species disappears mainly *in loco* without having either entirely or partly migrated beforehand caudalwards. The significance of the centriole ring has not been made out; it is suggested that it may be a part of the centriole which has arisen by excessive growth, and which is thrown off as useless or injurious to later function.

Tooth-development in Ornithorhynchus.§—J. T. Wilson and J. P. Hill describe the conditions of tooth development in two fœtal *Ornithorhynchi* of different stages. The facts set forth seem to establish the existence in *Ornithorhynchus* of teeth belonging to at least two

* Tidschr. Nederland. Vereen., 2nd series (April 1907) pp. 245–54 (1 pl.).
† Bull. Soc. Zool. France, xxxii. (1907) pp. 50–2.
‡ Arch. Mikr. Anat., lxx. (1907) pp. 330–59 (2 pls. and 4 figs.).
§ Quart. Journ. Micr. Sci., li. (1907) pp. 137–65 (3 pls.).

dentitional series. In the series to which the large multicuspidate teeth of the adolescent animal belong the authors reckon five members. They regard the epithelial nodules already described by Poulton and observed by themselves as vestigial teeth, and see in them a whole series of precursors of the molar teeth. These vestigial deciduous predecessors constitute a series of simple tooth-rudiments, each on the whole corresponding with one of the cusps of their multicuspidate molariform successors. It is not necessary to suppose that any ontogenetic fusion occurs. The mode of development of the successional molars in the younger stage is decisive against the occurrence of any fusion process. But the relation of the two series is suggestive of some sort of phylogenetic substitution of a small number of compound teeth for a large number of simple teeth. Further, no support is found for any theory which would seek to establish a serial distinction between the true molar teeth and those which appear, *prima facie*, to belong to the same series in front of them.

b. Histology.

Structure of Smooth Muscle.*—C. McGill has studied the structure of the smooth muscle of the intestine in the contracted state, utilising various mammalian and amphibian types. In all the forms studied it is a syncytial structure. In an area of contraction one or more thickened apparently homogeneous nodes appear, the internodal segments (which may be partially contracted) and the entirely relaxed muscle stain more lightly and are distinctly fibrillated. Even in the deeply staining contraction nodes it is possible to demonstrate the myofibrillæ, which take an active part in the contraction process. During contraction the smooth muscle nuclei shorten and thicken by an active process. The chromatin collects chiefly at the two ends of the nucleus, leaving a relatively clear area in the centre.

Organogenesis of the Œsophagus.†—J. M. Flint gives an account of the organogenesis of the œsophagus in the lower segment about the level of the forking of the trachea. The mucosa is derived from the simple epithelium of the head gut, which, in the early embryos, consists of a single or double layer of cubical or columnar epithelium. The trachea and œsophagus are practically separate from the head gut in pig embryos of 6 mm. long. The submucosa is developed primarily from the mesoderm about the head gut. In the early stages this consists of a syncytium of anastomosing cells which differentiate connective-tissue fibrils. These fibrils give rise to the trabeculæ and form the framework of the œsophagus, of which the submucosa is chiefly formed. The muscularis mucosæ in embryos of 7·5 cm. consists of loosely packed cells lying well outside the basement membrane. Subsequently they form an indefinite layer composed of smooth muscle fibres lying between the mucosa and the tunica muscularis. The tunica muscularis appears in embryos of 13 mm. as a densely packed group of cells, well outside the mucosa. In embryos of 7·5 cm. they form two more or less well

* Anat. Anzeig., xxx. (1907) pp. 426–33. † Tom. cit., pp. 442–51.

marked layers. At 11 cm. striations appear in the muscle fibres, while at the same time sarcostyles may be observed in them when they are viewed in cross section. The glands of the œsophagus at this level in pigs appear in embryos of about 21 cm. long. They originate as downgrowths of the mucosal epithelium which pass through the muscle bundles of the muscularis mucosæ into the deeper layers of the submucosa. These first downgrowths have a double row of low cubical cells. From the divisions at their ends are formed the primitive alveoli, while from the inner row of cells of these acini the mucous cells which push the outer row off towards the basement membrane are derived.

Mouth-cavity and Pharynx of Birds and their Glands.* — K. Heidrich gives a very detailed description of the macroscopic and microscopic characters of the mouth and pharynx of birds. The following points out of many may be noted regarding the glands of this region in the domestic fowl. These structures are very abundant in the submucosa. In the roof of the palate in front of the nares occurs the paired gl. maxillaris monostomatica; on both sides of the narial opening, the median (with about 120 openings), and the lateral (with about 35 openings) gl. palatinæ; on the roof of the jaws on both sides of the infundibular clefts, the gl. sphenopterygoideæ (with about 50 openings); on the floor of the mouth-cavity in the angle of the two rami the paired gl. submaxillaris anterior (with about 10–15 openings); behind this the gl. submaxillaris posterior in three parts; within the tongue the gl. linguales anteriores in two parts; at its base the gl. linguales posteriores (with about 100 openings); lateral to the glottis the gl. cricoarytænoidæ; and in the angle of the mouth the gl. angularis ovis monostomatica. All the salivary glands of the mouth and pharynx are pure mucous glands; granule-containing gland-cells were not observed, and in particular serous cells similar to the parotid cells of mammals do not occur. Intracapsular lymph-nodules occur, and are particularly abundant in the submaxillaries.

Branchial and Buccal Nerves in Ammocoetes branchialis.† — R. Fusari finds that the branchial nerves give off a large number of nerve bundles to the vessels and to all parts of the mucous membrane of the branchial apparatus. Other plexuses give off nerves to the branchial muscles and to the respiratory epithelium. In this last the termination is probably sub-epithelial. In other parts of the apparatus where the epithelium has two or three strata, the termination is intra-epithelial. The sense-bulbs are an exception, for the fibre terminates at the base of the bulb. True sympathetic ganglia were not observed in Ammocoetes, but there are many scattered sympathetic cells, and rich perivascular sympathetic plexuses are not wanting.

Neuroglia Syncytium in Batrachus.‡ — R. J. Terry describes a neuroglia syncytium in the brain of the Teleost, *Batrachus tau*, where the conditions are unusually favourable for study. The arrangement of the

* Morphol. Jahrb., xxxvii. (1907) pp. 10–69 (2 pls. and 16 figs.).
† Atti R. Accad. Sci. Torino, xlii. (1907) pp. 493–503 (1 pl.).
‡ Anat. Anzeig., xxxi. (1907) pp. 27–30 (2 figs.).

neuroglia is similar to that shown by Gierke and other observers, but the structure of the columns is different. They are composed of fibrillated protoplasm, not of closely applied fibres. Large, leaf-like masses of protoplasm lying between and connected with the radial axes, contain a few irregular fibres. There is no cell-membrane or differential exoplasm in any of the protoplasmic structures. The nuclei of the neuroglia lie for the most part near the internal limiting membrane, but others are scattered about the network. They are large, round or oval, and the protoplasm surrounding them varies from a thin even layer to a wide irregular mass. The neuroglia is, therefore, a syncytium comparable to that found in human and pig embryos.

Mitosis in Proliferating Epithelium.*—J. O. Wakelin Barratt has induced epithelial proliferation in the rabbit's ear by injection beneath the skin of Scharlach R. (azo-orthotoluol-azo-β-naphthol). In the epithelium proliferating *in situ* and in the same implanted under the skin both normal somatic and reduced mitoses occur. In the reduction mitoses the number of chromosomes which could be counted varied from 14 to 18. In the somatic form the number counted varied from 28 to 36. Reduction mitoses could be recognised less frequently than somatic mitoses. Post-reduction mitoses were met with.

c. General.

Nature of Living Organisms.†—A. E. Hilton discusses this question. Although he admits that any attempt to gain a forced clearness in regard to plasm is misleading, he thinks we can "combine the ideas before us into a practical working notion of automatic chemical machinery." Remembering that all things fundamentally consist of plasm, and that the activities of plasm are mainly concurrent, we have to realise : "(1) that plasm is a mobile, restless, unstable, watery colloid, with catalytic properties, growing by assimilation and forming structures by precipitation ; (2) that adaptation to environment and power of reproduction, are secured by reversible chemical processes ; and (3) that vitality is preserved by an automatic equipoise of forces maintained in equilibrium by reactions of carbon compounds, neutralisation of acid products, and by active, yet restrained, electrical energies."

Fusion of Atlas and Axis in Man.‡—G. Elliot Smith gives an account of a case of this somewhat rare abnormality. The case is remarkable in the fact that the ankylosis has not involved the separation of the odontoid from the axis. The arcus anterior of the atlas is fused to the front of the odontoid process, and the capsular ligaments surrounding the obliterated joints between the articular surfaces of the originally separate bones are ossified, as also is the anterior atlanto-axoid ligament, except at one spot on the left side where a foramen exists between the anterior arch of the atlas and the axis. The right side of

* Proc. Roy. Soc., Series B, lxxix., No. B 533 (1907) pp. 372–7.
† Journ. Quekett Micr. Club, x. (1907) pp. 41–50.
‡ Anat. Anzeig., xxxi. (1907) pp. 166–8 (3 figs.).

the ligamentum transversum atlantis has become ossified and ankylosed to the odontoid process. The superior articular surfaces of the atlas are not concave, but form a flat, sloping surface, on which the cranium can rotate, and thus in some measure compensate for the loss of rotatory movement which the immovable union of atlas and axis prevents. There is no trace of any pathological process: it is a clear case of developmental eccentricity.

Rare Vertebral Anomalies.* — A. Rauber describes two cases of abnormal vertebræ in man. In one case the sixth cervical vertebra was made up of two parts which separated on maceration. One consisted of both lower articular processes, and the terminal piece of the vertebral arch with its spinous process. This formed a posterior vertebral piece, whilst the larger and more anterior part consisted of the centrum, both transverse and both upper articular processes. This rare oblique division of the four articular processes into an upper and an under group is all the more remarkable in that the author describes a similar condition in the second lumbar vertebra of another adult subject. All the other vertebræ in the two individuals were normal.

Ossification of Human Sacrum.†—E. Fawcett describes the completion of this process, which may be summed up thus: Each auricular facet is formed in the main by the development and fusion of four costal epiphyses, two of which belong to S 1 and two to S 2. Each tuberosity is formed by the fusion of the costal epiphysis of S 3 and S 4 with the epiphyses of the transverse processes of S 4 and S 5. Each sacral transverse process (with the exception of the second) develops an epiphysis. The mammillary processes of the first sacral vertebra only are formed by epiphyses. Finally, the spines of the first three sacral vertebræ when complete develop an epiphysis.

Immunity in Hibernating Marmot.‡—R. Blanchard and M. Blatin have experimented with various Trypanosomes, Spirochætes, and Trichinæ in the active and hibernating marmot. In certain cases, e.g. *Trypanosoma brucei*, *T. gambiensi*, *T. evansi*, the marmot is susceptible when active, but when hibernating is absolutely immune. The parasites appear to die on account of the low temperature. The same result was got with Trichinæ. No effect was got with *Spirochæta duttoni* in either the active or hibernating animal.

African Mungooses.§ — R. C. Wroughton describes the various species of African mungoose usually referred to the *Herpestes gracilis* group. He finds that with the more abundant material at his command the group divides easily into two, one including the smaller, the other the larger forms, and that these two may each again be split up into two with well-marked distinguishing characters. A key to the proposed classification is followed by detailed notes on the forms examined.

* Morphol. Jahrb., xxxvi. (1907) pp. 602–8 (1 pl.).
† Anat. Anzeig., xxx. (1907) pp. 414–21.
‡ Bull. Soc. Zool. France, xxxii. (1907) pp. 32–40. See also Archiv Parasitol., xi. (1907) p. 361.
§ Ann. Mag. Nat. Hist., xx. (1907) pp. 110–21.

Solenodon paradoxus of San Domingo.*—A. H. Verrill describes the habits and external characters of this rare little mammal, which has for many years been considered extinct. He found that in certain isolated localities the natives were quite familiar with the animal, for which they have various names, such as "Orso" and "Ground Hog," but over the greater part of the republic it was absolutely unknown. He attributes its extermination to the presence of the mungoose. *Solenodon* is strictly nocturnal in its habits, awkward and shambling in its movements, and generally slow and stupid. The specimen captured was 14 in. in length, tail 13 in., body and head covered with sparse, coarse hair of a reddish colour on the head, dusky brown on the body. The legs, eyelids, snout and rump are naked, and pinkish-white in colour. The heavy tail is rat-like, the front claws large and mole-like, but much smaller than those of *S. cubanus*, and the snout is more flexible than in that form. The specimen was a female, and shortly after capture gave birth to three naked young, which she promptly devoured. She died three days later.

Families and Genera of Bats.†—G. S. Miller, jun., gives an account of the history, classification, and geographical distribution, with descriptions of the various genera. There is also a general account of the anatomy of bats in which certain special parts, e.g. the wing, shoulder-girdle, sternum, and the cusps of the teeth, which have not hitherto been adequately described, but which appear to be of particular taxonomic importance, are treated in some detail. The author concludes that at least 173 genera and 36 families and sub-families of bats should be recognised.

Extinct Fruit-Bat.‡—G. E. Mason describes a hitherto unrecorded frugivorous bat of the genus *Pteropus*, of which some remains were found during a survey of the little island of La Ronde, in the Mascarene group. From the bones of introduced animals found associated with the remains in question, it is evident that this form must have lingered in the island after the advent of man, and probably until a comparatively recent period. The name *Pteropus mascarinus* is proposed for this interesting species.

Pteropus mascarinus Mason.§—K. Anderson points out that this form is exceedingly like the now living species *Pt. rodricensis* Dobson, and regards it as closely related to, if not identical with that species, the measurements of which he compares in detail with those given for *Pt. mascarinus*.

Colour Sense in a Mercat.‖—F. Dahl has made a prolonged series of experiments to test the ability of a mercat, *Cercopithecus griseoviridis* Desm., to distinguish colours. He found that the animal could distinguish red from green, and white from golden yellow, and dark green from black. It could also recognise the red in orange contrasted

* Amer. Journ. of Science, clxxiv. (1907) pp. 55–7 (1 fig.).
† Smithsonian Inst., U.S. Nat. Museum, Bull. 57 (1907) pp. 1–282 (14 pls.).
‡ Ann. Mag. Nat. Hist., xx. (1907) pp. 220–2. § Tom. cit., pp. 351–5.
‖ Zool. Jahrb., xxv. heft 2 (1907) pp. 329–38.

with golden yellow, and in violet contrasted with blue. It learned by experience, and did so more quickly the second time than the first. But it had great difficulty in learning to distinguish a beautiful cobalt blue from black.

Tuberculosis in Guinea-pigs.*—A. Calmette, C. Guérin and M. Breton, following up their experimental work on tuberculosis in cattle, have made a series of experiments on guinea-pigs, inducing artificial tuberculosis by infection through the alimentary canal. They found that when young or adult guinea-pigs were thus infected, according to a method they fully describe, they invariably developed tuberculosis, and that the lesions they exhibited were chiefly pulmonary and ganglionic. The spleen and visceral organs were rarely implicated, though tracheo-bronchial adenopathy and tubercular arthritis were frequent. Bacilli killed by heat or by maceration in alcohol proved toxic to the guinea-pig through the alimentary canal. The same bacilli killed by heat or chemically treated and absorbed by the alimentary canal in minimal doses and at sufficient intervals conferred a marked resistance to virulent infection.

Wolves of Spain.†—A. C. Latorre regards the type *Canis lupus* L. as approximately the same stem as the Castilian wolf, but of a paler skin, and with other differences of coloration. Both forms are gigantic compared with the one inhabiting the south-east corner of the peninsula, which in size and appearance resembles a jackal. The three forms *C. lupus lupus*, *C. l. signatus* sub-sp. n., *C. l. deitanus* sub-sp. n., are described.

Kidney of African Elephant.‡—A. Pettit describes the anatomy of this organ, and in particular calls attention to its interlobular muscular tissue which appears to be specially marked. The kidney is a plurilobed organ characterised by the development of a contractile partition system.

Perdrix montana Brisson.§—E. Olivier calls attention to the variations of the grey partridge (*Starna cinerea* Lath.), and in particular discusses the case of *Perdrix montana*, described as a new species by Brisson. Olivier states that this remarkable form appears by chance here and there at long intervals amongst other *Perdrix*; there is always the same constancy in its colorations, but it does not breed its own type. It is a variety whose origin is very puzzling.

New Reptiles from Karroo Beds of Natal.‖—R. Broom describes a small collection of reptilian bones from the Karroo Beds of Natal. Most of the specimens belong to a large *Dicynodon*, which proves to be a new species, *Dicynodon ingens*, and there is also a specimen of a new species of Therocephalian, *Scymnosaurus warreni*. Three Natal species are now known, and though they belong to well-known genera, they are all very distinct from the species known in Cape Colony. This is a

* Ann. Inst. Pasteur, xxi. (1907) pp. 401–16.
† Bol. R. Soc. Españ. Hist. Nat. Madrid, vii. (1907) pp. 193–7 (1 pl.).
‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 712–14.
§ Bull. Soc. Zool. France, xxxii. (1907) pp. 72–3 (1 fig.)
‖ Ann. Natal Govt. Museum, i. (1907) part 2, pp. 167–72 (1 pl.).

little remarkable, considering that the forms from the Western Karroo beds are identical with those from similar horizons in the Eastern Province. Very likely the Natal species may yet be found in Cape Colony when the beds are more fully worked.

Nesting Habits of Florida Alligator.*—A. M. Reese finds that the eggs of the Florida alligator are mostly laid in the month of June. The nest, which is probably made by the female, is placed on a slight elevation near the bank of the "hole" in which she lives. This elevation is generally, though not always, a sunny spot. The female alligator stays in the neighbourhood of the nest after she has filled it with eggs, but it is extremely doubtful whether she defends it from the attacks of other animals. Certainly man is in very little danger when he robs the nest, and it appears that bears are persistent hunters and eaters of the eggs. The nest consists of a mass of flags or marsh grass gathered together, piled into a conical or rounded heap, and packed down by the builder repeatedly crawling over it. The nests vary in size and form, and may be 2 m. in diameter, and sometimes quite flat. The average number of eggs per nest in twelve instances was 31. They are laid without any apparent arrangement, are buried in a hole amongst the damp decaying substance of the nest, and covered over so that without examination it is impossible to tell whether in a given nest eggs are present or not. It seems likely that the conditions that are specially favourable to normal incubation are moisture and an even though not necessarily an elevated temperature. The complete process of incubation probably extends to about eight weeks. For some hours previous to hatching the young alligators make a curious squeaking sound inside the shell which may be heard several yards away. This is probably to attract the female alligator so that she may open the top of the nest so as to allow them to escape from the closely-packed mass of decaying vegetation. There is considerable variation in the size of the egg, more in the long than in the short diameter. The longest of more than four hundred eggs was 85 mm., and the shortest 65 mm. The widest egg was 50 mm., and the narrowest 38 mm.

New Pit-Viper.† — G. A. Boulenger describes a new species of pit-viper, of which two specimens were sent to him from the city of Itapetininga, in Brazil. The species is remarkable for its small size, the specimens in question—the largest so far obtained—measuring only 400 mm. in length. The name *Lachesis itapetiningæ* is proposed for the new species, which is closely related to *L. neuwiedii* Wagl., but is easily distinguished from it by its stouter form, as expressed by the lower number of ventral and caudal plates.

Breeding Habits of Amblystoma.‡ — B. G. Smith describes the spermatophores of *Amblystoma punctatum*, which were found as snow-white tufts firmly attached to leaves, twigs, etc., at the bottom of a pond, in groups of 40 or 50 together. Each consists of a gelatinous base or

* Smithsonian Misc. Collections, xlviii. (1907) pp. 381–6 (2 pls.).
† Ann. Mag. Nat. Hist., cxviii. (1907) p. 338.
‡ Amer. Nat. xli. (1907) pp. 381–90 (1 fig.).

stalk covered with a white felt-like cap of spermatozoa with no visible matrix. The structure of the spermatozoa is fully described, and a general account of the breeding habits is given. Fertilisation is internal, but the spermatophores are so numerous that it is possible that they are picked up by the female by chance contact.

Pigments of Batrachians.* — A. Magnan describes the general properties of the pigments extracted from the skin of Batrachians, *Pelobates fuscus*, *Rana temporaria*, etc. Green, yellow, red, black, yellowish brown pigments are found to be related, for the darkest may progressively become the lightest under different influences. But the opposite transformation was never observed.

South African Barbels.† — G. A. Boulenger describes two new species of *Barbus* from Africa, thus bringing up the number of recorded African species to eight. The first species described, *B. aspilus*, came from the Ja River, S. Cameroons; the second, *B. trispilomimus*, probably from the Congo. Only a single specimen of each has been procured.

Teleostean Scales.‡—A. Hase has made a study of the form and structure, the origin and arrangement of Teleostean scales. The results may be summarised as follows: The scales consist of two layers, an outer, or hyalodentine, and an inner, or fibrous layer. They originate from an oblique papilla (the scale-rudiment), which consists of modified cuticular cells or scleroblasts. These are of purely mesodermal origin; the regressive metamorphosis undergone by the basal epidermis-cells is not connected with scale-formation. The scale is inserted in a special "scale-pocket" formed from loose connective-tissue. The secretion of hard substance is due to two scleroblast layers which lie above the scales. The body-segments surround the vertebral column in "W-like" lines, and the oblique rows of scales correspond exactly to these. They therefore correspond in number to the vertebræ also.

An introductory section treats of the "scale problem" in its historical aspect, and the final section deals with the phylogeny of scales. There is a copious bibliography.

Parietal Sense-apparatus in New Zealand Lamprey.§— A. Dendy describes the parietal sense-organs and associated structures in *Geotria australis*. The structure of the pineal organ (right parietal eye) and parapineal organ (left parietal eye) is essentially identical, although the former is much more highly developed than the latter. The connection of each of the two sense-organs with the corresponding member of the habenular ganglion pair need no longer be questioned. The marked asymmetry in point of size of the two habenular ganglia, and of the two bundles of Meynert, corresponds exactly to the unequal development of the two parietal sense-organs with which they are connected, and leaves no doubt as to the paired character of the whole system.

* Comptes Rendus, cxliv. (1907) pp. 1130–2.
† Ann. Mag. Nat. Hist., cxviii. (1907) pp. 336–7.
‡ Jen. Zeitschr. Naturw., xlii. (1907) pp. 607–64 (3 pls. and 26 figs.).
§ Quart. Journ. Micr. Sci., li. (1907) pp. 1–30 (2 pls.).

Everything points to the fact that the function of the pineal organ is that of light perception, and it may, therefore, be spoken of as an "eye." Its structure is such that in lampreys it is incapable of forming images. Its function here is probably that of responding to variations in the intensity of the illumination to which it is exposed. The parapineal organ in *Geotria* lies in front of the pineal eye, exposed to the light, and although degenerate, is probably still in some degree functional.

Nest of the Kelp Fish.*—C. H. Holder describes and figures the nest of the so-called kelp fish, *Heterotrichus rostrata*, which is found in the great kelp-beds of the shores of S. Carolina. The fish usually resembles very closely the sea-weed on which it lives, but during the breeding-season the colours of the male are highly intensified and brilliant. The female, in captivity, was seen to examine a bunch of sea-weed, pushing her way through it and passing many times round it, depositing as she went a pure white, viscid cord, which clung to the branches, and on which were many small white eggs. The male mounted guard while the female rested. The whole nest took two hours to complete, and formed a globular white mass about the size of a hen's egg.

Abnormal Turbot.†—J. T. Cunningham describes a peculiarly abnormal specimen of young turbot, presenting a condition never before described in any species of flat fish. The eyes of this specimen are both on the right side instead of, as normally, both on the left. In colour the specimen partially resembles a normal specimen, the right side being unpigmented, the left side normal. The head and anterior region of the right side have more pigment than the rest of that side. The anterior end of the dorsal fin forms a projecting hook-like process over the dorsal eye. The specimen was kept alive for some weeks, and presented the extraordinary spectacle of a flat fish white on the upper side and coloured on the lower. Exposure to light had so far produced very little effect on the white side.

The condition, which is that of a turbot with a reversed head attached to a normal body, is regarded as certainly congenital, and the abnormal position of parts as due to the abnormal position of parts of the ovum from which they were developed.

Fresh-water Cottidæ of Russia.‡—V. Gratzianow gives an annotated classification of the Cottidæ occurring in the fresh waters of the Russian Empire. Nineteen species are recorded, one of which, *Cottus koshewnikowi* Gratzianow, a form with a wide distribution, is new. Two new genera, *Cephalocottus* and *Mesocottus*, are established, each with a single species, viz. *Cephalocottus* (*Cottus*) *amblystomopsis* Schmidt and *Mesocottus* (*Cottus*) *haitei* Dybowsky respectively. *Cottus minutus* Pallas it may be noted has the widest distribution of all the fresh-water Cottidæ; it is known in the Pyrenees, Lapland, various parts of North Siberia, Ochotsk Sea, the Amur basin, and Korea.

* Amer. Nat., xli. (1907) pp. 587–8 (1 fig.).
† Journ. Marine Biol. Assoc., viii. (1907) pp. 44–6 (1 pl.).
‡ Zool. Anzeig., xxxi. (1907) pp. 654–60.

Comparative Anatomy of Mammalian Ear-cartilage.*—J. E. V. Boas describes the cartilage of the external ear in a number of mammalia. In the placental mammals there is a common type with a definite number of indentations and lobes. Though variously modifiable, and with the parts very unequally developed in different forms, yet even to details they are found to agree in types so far apart as pig and dog. This agreement as to type holds good for degenerate ears also.

Tunicata.

Embryology of Oikopleura.†—K. Kellner describes certain embryos of an *Oikopleura* which occur "rooted" in the tail of adults. They form little pear-shaped bodies and were previously, but erroneously, regarded as gland-cells. The eggs are smaller than those of any other known Tunicate, and the embryos evidently are parasitic upon the adults, drawing nourishment through a root-like process. They occur in large numbers on the south coast of Florida.

INVERTEBRATA.

Mollusca.

Mollusca of the Ozarkian Fauna.‡—H. A. Pilsbry and James H. Ferriss give an annotated list of the species of Mollusca of the Ozark Mountains, Arkansas, and discuss the faunal relations of this region. Its topography affords conditions favouring the evolution of special forms, and many have probably been evolved where they now occur. About 36 p.c. of the total number of land snails listed are peculiar to the region. Some aquatic forms, Unionidæ and Pleuroceratidæ, are also characteristic, although in the main Mississippian species rule.

γ. Gastropoda.

Molluscan Radula.§—Igerna B. J. Sollas has investigated the chemical composition of the radula in a number of Molluscs. In all, the radula has an organic basis of chitin; the Docoglossa are unique among Mollusca in the composition of their teeth, of which the most important constituent is silica hydrate or opal. All the other groups, including the Rhipidoglossa, form a second type in which the radular chitin is hardened superficially by deposits containing calcium, iron, and phosphoric acid, which, together, perhaps with an additional organic substance, form that outer covering so long known as the enamel layer, but hitherto unexplained. In the Chitonidæ ferric oxide is the most important mineral constituent, and is the cause of the dark colour of the teeth. Some facts are given regarding the development of the radula, e.g. as to the microscopic changes in the teeth subsequent to their formation. These changes point to the secretory nature of the roofing epithelium of the radula sac.

* Anat. Anzeig., xxx. (1907) pp. 434–42 (6 figs.).
† Zool. Anzeig., xxxi. (1907) pp. 653–4 (2 figs.).
‡ Proc. Acad. Nat. Sci. Philadelphia, lviii. (1906) pp. 529–67 (3 pls.).
§ Quart. Journ. Micr. Sci., li. (1907) pp. 115–36 (1 pl.).

Progression of Rhipidoglossidæ.*—A. Robert has analysed the movements of the foot in the Rhipidoglossidæ in locomotion. The process may be briefly described thus. Each half of the foot progresses like a caterpillar. The total movement is like that of two caterpillars which, instead of crawling parallel fashion by the simultaneous contraction of their homologous rings, on the contrary alternate their contractions.

Morphology of Pyrula.†—Burnett Smith has made a study of some of the "morphologic changes" of the genus *Pyrula* as observed within the restricted range from the Eocene to the present day. The distinctions between the species are so slight, and they are all so unlike the examples of other genera, that they may well be regarded as a single genetic stock. The more important changes which have taken place since the late Eocene are found not so much in the adult sculpture as in the features of the apex. Without entering into details, the most important points emphasized may be noted. (1) We may have living at any one time on the earth's surface an assemblage of closely related Gastropod species which differ to a marked degree in the evolutional grades which they have attained. (2) In a group of closely related Gastropod species, the chief modifications which are introduced with the passage of time may occur mainly in the features of the early whorls, while the later adult whorls may remain relatively unchanged. (3) In this particular group of species, the differences in the apical characters cannot be used for the division of the assemblage into separate genera, but are of use only as aids to specific discrimination, and then only when the characters of the later whorls are considered together with those of the apex.

Arthropoda.

a. Insecta.

Maturation in Spermatogenesis of Vespa.‡—E. L. Mark and M. Copeland describe the maturation of the spermatocyte in *Vespa maculata*. At one end of the cell, termed by the authors the proximal, a small bud of cytoplasm containing the interzonal body (the remnants of the interzonal filaments of the preceding cell-division) and the proximal centrosome is protruded. For a time it remains connected with the cell by a neck-like process of cytoplasm, through which may be traced extra-nuclear fibres. This connecting process attenuates and breaks, and the bud is detached. This "Richtungskörper" consists chiefly of the interzonal body, but in most cases the interzonal body is surrounded by more of the unmodified cell-protoplasm than exists in the corresponding globule in the honey-bee. There is evidence that the proximal centrosome divides, and that the two daughter-centrosomes, in some cases at least, move apart around the periphery of the globule. After the formation of the non-nucleated "Richtungskörper," the cell divides and two spermatids equal in size result. These are immediately metamorphosed into spermatozoa.

* Bull. Soc. Zool. France, xxxii. (1907) pp. 55–62.
† Proc. Acad. Nat. Sci. Philadelphia, lix. (1907) pp. 208–19 (1 pl.).
§ Proc. Amer. Acad. Arts and Sci., xliii. (1907) pp. 71–4 (8 figs.).

Spermatogenesis of Honey Bee.* — L. Doncaster re-describes the final maturation division regarding which his previous account erred. In the anaphase there are 16 very small chromosomes at each end. When the spindle is formed, 16 chromosomes arrange themselves in the equatorial plate in such a way that they are generally closely associated together in pairs. It may sometimes be seen that each individual member of the pair is in itself double or dumb-bell shaped, and when the division takes place the members of a pair are not separated from one another, but each divides so that the 16 halves pass to each pole. These results are in essential agreement with those of Mark and Copeland.

Gametogenesis and Fertilisation in Nematus ribesii.† — L. Doncaster thus summarises the results of his investigations. True fertilisation (conjugation of male and female pronuclei) may take place in *N. ribesii*, and the behaviour of the polar nuclei is slightly different in fertilised and virgin eggs. In the spermatogenesis there are eight chromosomes in spermatogonial divisions; four gemini appear at the beginning of the maiotic phase, and by heterotype and homotype mitoses distribute four chromosomes to each spermatid. In the oogenesis eight chromosomes appear in oogonial mitoses, but in divisions of nuclei in the ovary-sheath more than eight are found, suggesting that the chromosomes of the germ-cells are compound. In the polar mitoses of the egg two types of maturation are found. In some eggs there are successive equation divisions, so that the egg nucleus and each of the three polar nuclei contain eight chromosomes. In other eggs normal reduction takes place, separating entire chromosomes from one another, and only four are found in each of the daughter-nuclei. It is probable that only such reduced eggs are capable of fertilisation, but when unfertilised they may continue to develop at least as far as the blastoderm stage.

Variation in Parthenogenetic Insects.‡—Vernon L. Kellogg has utilised drones (parthenogenetically produced) and worker honey bees (of bisexual parentage), also female aphides (parthenogenetically produced) to test the value of amphimixis in causing variations. With regard to the bees in all but one of the characteristics studied, the amount of variation, both quantitative and qualitative, is markedly larger among the drone bees than among the workers, and in the one exceptional characteristic it is no less. No more variation in wing characters is apparent among drones or workers that have not been exposed in imaginal condition to the rigours of personal selection, than exists among bees, drones, or workers that have been so exposed. The variation in wing characters in drone bees reared in worker cells is no greater than that among individuals reared in drone cells. The variation among drones hatched from worker-laid eggs is markedly larger than that among drones hatched from queen-laid eggs (the drones of worker parentage are considerably smaller than those of queen parentage). In

* Anat. Anzeig., xxxi. (1907) pp. 168–9.
† Quart. Journ. Micr. Sci., li. (1907) pp. 101–13 (1 pl.).
‡ Science, xxiv. (1906) pp. 695–9.

the case of the aphides the coefficients of variation for meristic variations are notably large—as large as those in mosquitos, ants, etc., where amphimixis is the rule. "Amphimixis is not only not necessary in order to insure Darwinian variation, but there is no evidence that I am aware of to show that it increases this variation."

Mutation in Mosquitos.*—S. E. Weber gives an account of some very remarkable observations, the nature of which may be gathered from the following samples. From a mass of 352 eggs deposited by *Culex pipiens*, 43 adults were reared. "Three of these were *C. restuans* Theobald (females), two were a variation from *C. restuans*, females, and two others, also females, were of the same beautiful deep, cherry-reddish-brown tint with all the other parts as to colour and size like the *C. restuans* and variation, but did not have the scaled spots on the dorsum." The identification of the *C. restuans* was confirmed by D. W. Coquillett, of the U.S. National Museum. Other results obtained were *Culex pipiens* and *C. restuans* larvæ from eggs of *C. salinarius* Coquillett, which larvæ reverted to *C. salinarius* adults; *C. restuans* eggs and larvæ which produced *C. pipiens* adults; *C. pipiens* larvæ and adults as mutants from *C. salinarius* eggs; and so on. "We have in these phenomena of changes the process or scheme of nature by which new species are produced."

Fenestræ of Periplaneta orientalis.†—B. Haller has investigated the structure and nerve relations of these bodies, and concludes that they are degenerate ocelli which no longer function in light perception, but constitute a special sense-organ. There is no doubt that they are homologous with the ocelli of other insects.

Sarcophaga Larva in Human Intestine.‡—E. Warren records the occurrence in the intestine of two Europeans in Natal of fly larvæ, one of which on being bred out proved to belong to the genus *Sarcophaga*. The species is undetermined. The larva possesses no special organs for adhering to the mucous membrane of the alimentary canal, and it is possible that the parasitic habit is purely accidental. It is certain that in the case from which the fly was bred no flesh was eaten, but as large numbers of larvæ have been seen escaping from the body of a female of a *Sarcophaga* without any apparent effort on her part, the contamination of food-stuffs such as bread, by the minute white grubs, is easily conceivable.

Internal Metamorphosis of Trichoptera.§—H. Lübben describes the phenomena of metamorphosis as observed in the gut, respiratory, and sexual organs. Some of the internal larval organs develop progressively onward to the imaginal state, e.g. the sexual organs; others undergo histolysis, to be reconstituted in the pupa stage, e.g. the muscles. The tracheæ occupy an intermediate position as regards these processes, since in the Trichoptera they in some part degenerate and in others persist.

* Weber's Archives, i. (1907) No. 2, Lancaster, Pa., pp. 1–28 (6 figs.).
† Zool. Anzeig., xxxi. (1907) pp. 255–62 (4 figs.).
‡ Ann. Natal Govt. Museum, i. (1907) pt. 2, pp. 215–8.
§ Zool. Jahrb, xxiv. (1907) pp. 71–128 (3 pls.).

Senses of Ants.*—O. C. Silverlock publishes the results of a series of experiments carried on during the last two years with a view to finding out whether ants are susceptible to the slight differences of temperature between the different portions of the spectrum. He concludes that ants are sensitive even to a rise of 0·3° C. of temperature, and that their appreciation of heat and cold is much more delicate than our own.

Insect Tree Pests.†—E. P. Felt describes the white-marked tussock moth and the elm-leaf beetle, two leaf-feeders which cause very serious damage to shade trees, especially in cities and villages in New York State. Both insects are fully described and figured, and an account is given of their life-histories, their food-plants, their natural enemies; and remedial measures are suggested.

New Parasitic Proctotrypid.‡—A. W. Morrill describes a species, believed to be new, of *Telenomus* (*T. ashmeadi*), which is parasitic on the eggs of some insects, and especially on those of a Pentatomid bug, known as "conchuela," which is extremely destructive in the Mexican cotton-fields. The great economic importance of the parasite may be inferred from the fact that of 41 batches of Pentatomid eggs collected, 36 were infested by the parasite and completely destroyed. An interesting account of the habits and life-history of the parasite is given, and the probable relation between the occasional parthenogenesis and the proportion of the sexes in the offspring is discussed.

Mouth-parts of Ephemeridæ.§ — R. Sternfeld has studied the degeneration of the mouth-parts and the change of function of the intestine of the Ephemeridæ, with special reference to their bearing on the theory of descent. He finds that the degeneration of the mouth-parts begins in the nymph stage, is externally complete in the sub-imago, and quite complete in the imago. The individual organs do not undergo equal degeneration, but the various genera do not differ much from one another in this respect. There is no apparent connection between the state of development of the larval mouth-parts in the different genera and the degeneration in the imago. The intestine is not a rudimentary structure. It is filled with air in the imago, and serves to increase the power of flight and especially of soaring. This new function of the intestine is of even greater biological importance than the one which is lost, since it increases the adaptation of the short-lived insects for rapid and certain pairing.

Tracheal Gill-musculature in Ephemeridæ.‖—B. Dürken gives a very full account not only of the tracheal gill-musculature but of the body musculature in general. His facts are too numerous to summarise, but it may be noted that he concludes there is no ground for homologising the gill and thoracic muscles, and in consequence tracheal gills

* Nature Notes, xviii. (1907) pp. 165-9.
† Bull. New York State Museum, cix. Entomology, 27 (1907) 14 pp., 8 pls.
‡ Amer. Nat., xli. pp. 415–30 (1 fig.).
§ Zool. Jahrb., xxiv. (1907) pp. 413–29 (1 pl. and 21 figs.).
‖ Zeitschr. Wiss. Zool., lxxxvii. (1907) pp. 435–550 (3 pls. and 30 figs.).

and wings are not to be related. Though both are of tergal nature they have arisen independently of each other. The characters of the musculature are such as to separate the Ephemeridæ from the Libellæ and Orthoptera.

Silk-glands of Apanteles.*—R. Matheson and A. G. Ruggles give an account of the structure of the silk-glands of *Apanteles glomeratus*, a hymenopterous social parasite on the larvæ of the common cabbage-moth. These glands differ from those in the Lepidoptera and Trichoptera, in that there are four tubes in the abdominal region, but their histological structure is similar. It differs markedly, however, from that described for the Teuthredinid larvæ. In immature larvæ the epithelial cells of the whole silk-producing region are actively secreting. Numerous vacuoles are present in these cells. In mature larvæ the abdominal division becomes greatly distended and its cells have probably ceased secreting. The glands of Phillipi are absent. The press is well developed, but the lateral pair of muscles present in Lepidoptera are absent. The product of the gland is a double thread.

Disease in Bees.†—A. D. Imms reports on a very fatal disease in bees which made its first appearance in the Isle of Wight in the summer of 1904. It was regarded by bee-keepers as "paralysis," but differs in several respects from the ordinary bee paralysis. The most prominent symptom was great enlargement of the hind-intestine, and microscopical investigation revealed an impacted mass of pollen-grains mixed with ordinary beeswax and numerous bacteria. A connection between this disease and "dysenteric conditions" is suggested, but, pending further examination and experiment, only general hygienic measures can be recommended. Removing the store of pollen and supplying beef-juice mixed with honey or sugar to satisfy the inordinate appetite for nitrogeneous food characteristic of the disease, is suggested.

Life-history of Pieris Brassicæ L.‡—G. Martelli describes the copulation, oviposition and various features in the development of *Pieris brassicæ*, and gives a similar account of a number of hymenopterous and dipterous parasites and hyperparasites.

Rudiments of Wings and Halteres in Melophagus.§—P. Stange has followed the development of these structures in *Melophagus ovinus*. The wing disks (Flügelscheiben) give rise to rudimentary wing cones (Flügelzapfen), the rudiments of the halteres give rise to a large stigma. It is noteworthy that the "Flügelzapfen" are beset with bristles such as occur on the outer edge of the wing in Musca, "an inheritance from the time when *Melophagus* had not yet become a parasite in the wool, and perhaps bore well developed flying organs."

Structure of Compound Eye in Muscidæ.‖—Pierre Vigier describes the light receptive terminations in the compound eyes of Muscidæ.

* Amer. Nat., xli. (1907) pp. 567–81 (3 pls.).
† Journ. Board of Agric., xiv. (1907) pp. 129–40 (2 pls.).
‡ Boll. Labor. Zool. R. Scuola Agric. Portici, i. (1907) pp. 170–224.
§ Zool. Jahrb., xxiv. (1907) pp. 295–322 (2 pls. and 3 figs.).
‖ Comptes Rendus, cxlv. (1907) pp. 532–6 (1 fig.).

The rhabdomeres, which all agree in regarding as the receiving terminations for luminous impressions, consist of two portions placed in line with each other. There is a short terminal highly refringent and homogeneous rod situated in the cavity between the pseudocone and the pigmentary iris. There are seven (not six as Hickson has stated) rods united in a fascicle with fixed relations which are the same for all the ommatidia of the same region of the eye. These rods are continued as a long and more slender stalk in the deep layer, and these possess a heterogeneous structure analogous to that which characterises all the photo-receptive elements, including the cones and rods of the Vertebrates. The seven rhabdomeres of the ommatidia remain distinct; they belong to seven retinular cells, each of which emits a conducting fibre into the deep cells.

Sac surrounding Pupæ of Ichneumonidæ.*—J. E. V. Boas describes a peculiar sac within which were pupæ of an ichneumon-fly *Anomolon circumflexum* L. parasitic on pine-moth pupæ. The parasite was found inside the empty chitinous husk of the pupa, and within the cocoon, investing it closely, was a gelatinous brownish sac filled with a dark brown fluid. The sac was invaginated at one end to receive the large abdominal portion of the pupa. Full grown larvæ were sometimes found in similar sacs, and an examination of larvæ at all stages showed that the sacs were the contents of the intestine inclosed in the lining membrane of the mid-gut, and expelled towards the close of larval life. Analogous fæcal sacs are expelled by many insects, but the turning of the sac to account as a protective cushion for the pupa has not hitherto been observed in regard to any other form.

Structure of the House-fly.†—C. G. Hewitt, in the first of three papers on the structure, development, and bionomics of *Musca domestica*, deals with the anatomy of the insect, of which no complete account has hitherto been published. On morphological grounds, the author adopts the view that the distal portion of the proboscis represents the modified second maxillæ or labium, and is not derived from the first maxillæ. The tracheal system is described with special minuteness. There are two thoracic spiracles, the first supplying the whole of the head, the anterior and median regions of the thorax and the three pairs of legs, and, by means of air sacs, a large part of the viscera. The second supplies the muscles of the median and posterior region of the thorax. There are seven pairs of abdominal spiracles in the male, and five in the female. The extension of the proboscis is believed to be due to the inflation of the tracheal sacs of the head and rostrum, and that of the oral lobes, which contain only annulated tracheæ, is probably effected by blood-pressure.

New Hercules Beetle.‡ — A. H. Verrill gives some notes on *Dynastes hercules* and other beetles collected on Dominica island. Variations in colour and markings are so numerous and grade so imperceptibly into one another that it is not possible to distinguish

* Zool. Jahrb., xxv. heft 2, pp. 321-7 (1 pl.).
† Quart. Journ. Micr. Sci., li. (1907) pp. 394–448 (5 pls.).
‡ Amer. Journ. Sci., clxxiv. (1907) pp. 305–8.

colour varieties which are constant. But one form occasionally obtained was so distinct and so remarkable that it is described as a new and distinct species or sub-species, *D. argentatum*. In size, general shape, processes of head and thorax, it is indistinguishable from *D. hercules*, but the head, thorax, legs, etc., are jet black. The elytra are pale plumbous, silvery grey, or white with a silvery metallic sheen, edged and spotted with black. This form was found on the interior mountain ranges of the island.

Orthoptera of Paraguay.*—J. A. G. Rehn gives a record, with in many cases descriptions, of the non-saltatorial and acridoid Orthoptera of Sapucay, Paraguay. Seven new species are described, and in many cases notes on the variability of series, both in size and coloration, have been given. The region is evidently very rich in species of Orthoptera.

Note on Assortative Mating.†—Vernon L. Kellogg describes the case of the ladybird beetle, *Hippodamia convergens*, an insect of much variability as to its dorsal colour pattern. An opportunity occurred (unfortunately interrupted by an earthquake) of studying their mating, and particular attention was given to the question as to whether it was assortative. The evidence, as far as it goes, indicates that the matings were wholly non-selective; they are chance matings—that is, follow the law of probability. The relative proportion of numbers of the different colour types determines the matings; they are, therefore, not assortative.

δ. Arachnida.

Spider Threads.‡—J. R. Benton has made a series of experiments to test the strength and elasticity of spider-thread. He finds that the material of the thread possesses quite a high tensile strength, about double that of most kinds of wood. The results of these experiments differ so greatly from those of Beaulard on the mechanical properties of silk, that the investigator concludes that the material of spider-thread is not identical with silk, as is sometimes asserted.

New Oribatidæ from the United States.§—Nathan Banks describes twenty-four new species of Oribatidæ from various parts of the United States. This fauna appears to be similar to that of Europe, with the exception of one or two peculiar genera. There is a larger percentage of smooth genera, as *Galumna*, *Oribatula*, and fewer of the roughened types, as *Notaspis*, *Nothrus*, and *Cepheus*. The genus *Pelops*, represented in Europe by ten or twelve species, has not yet been found in North America.

Bionomics of Pycnogonidæ.‖—J. C. C. Loman gives an account of the habits and life-history of this group, especially of those members

* Proc. Acad. Nat. Sci. Philadelphia, lix. 1907, pp. 151–92.
† Science, xxiv. (1906) pp. 665–6.
‡ Amer. Journ. Sci., clxxi. (1907) pp. 75–8.
§ Proc. Acad. Nat. Sci. Philadelphia, lviii. (1906) pp. 490–500 (5 pls.).
‖ Tijdschr. Nederland Dierkund. Vereen., 2nd Series, April 1907, pp. 254–82 (24 figs.).

of it found about the coasts of the North Sea. He confirms Hoek's list of species, and shows that they live exclusively upon colonies of hydroid polyps. His detailed observations were made in regard to *Phoxichilidium femoratum*, which attaches itself to the polyps of *Tubularia larynx*. He finds himself unable to agree with Dohrn as to the absence of excrement, and his observations as to the genital organs also differ from those of previous investigators. The female sea-spiders are easily distinguishable from the males, since the latter are pale in colour and greatly increased in size by the number of balls of eggs they bear. Fertilisation is external. Larvæ at all stages were readily procured by gently pressing the polyps, and the author discusses the question as to how the larvæ get within the digestive tube of the polyp, and the problem of the relation between the larval appendages and the limbs of the adult animal. He finds that the typical protonymphon stage is common to all the Pantopoda, whether it be gone through within or without the egg. In the form in question a great part of the development occurs within the egg.

ε. Crustacea.

Phyllopod Studies.*—N. v. Zograf makes some notes on the structure of the Phyllopod ovary of which there are two types, a cylindrical tube-form characteristic of the Branchiopods, and a very much branched canal as occurs in the shell-bearing Phyllopods. The formation and growth of the eggs, and structure and mode of formation of the egg-envelopes are described. Two cases of hermaphroditism in *Lepidurus productus* are discussed.

New Species of Artemia.†—Vernon L. Kellogg describes a new species discovered in the evaporating pools of salt works near Stanford University. It differs markedly from the other American species in those characteristics upon which Verrill relies to distinguish the already known American forms, viz. the shape of the male claspers, the female egg-sac, and the character of the caudal appendages. Size is an unreliable feature, for it varies under different conditions of density of the water. In addition to a description of this new form, *Artemia franciscana*, notes are given of differences due to varying environmental conditions. Differences in the proportional length of the post-abdomen to the rest of the body, in the character of the abdominal segmentation, and in the length and hairiness of the caudal appendages, are apparent in this new *Artemia*, and evidently bear a definite relation to the different densities of the pools in which they are living.

Post-embryonal Development of Caridina wyckii Hicks.‡—E. von Daday describes the larval stages, euzoea, mesozoea, metazoea, protomysis, mesomysis, metamysis, and postmysis, the gradual transformation of the individual organs (antennæ, mouth appendages, and limbs) and gives a brief comparison of the course of development in a few nearly related Decapod species and in *Caridina*.

* Zeitschr. Wiss. Zool., lxxxvi. (1907) pp. 446–522 (4 pls. and 2 figs.).
† Science, xxiv. (1906) pp. 594–6.
‡ Zool. Jahrb., xxiv. (1907) pp. 239–94 (3 pls. and 1 fig.).

Primitive Schizopod Crustacean.* — H. Woodward gives an account of some additional specimens of *Pygocephalus cooperi*, a primitive Schizopod crustacean from the Coal measures. Huxley first described this form in 1857, and all the specimens that have been examined since then have merely served to amplify and corroborate his observations in regard to the males. But among some specimens recently obtained from a bed of clay-ironstone nodules at Coseley, near Dudley, were two which were clearly female. These show most distinctly, on the ventral aspect of the thorax, the presence of a brood-pouch or marsupium, consisting of 6 or 7 broad scale-like imbricated plates, the "oostegites." Such structures are well known in many recent Crustaceans, but have not hitherto been preserved in any fossil form. Two less perfect females have since been detected in the British Museum collection.

Annulata.

New Polychæta from Massachusetts.†—J. Percy Moore describes *Arabella spinifera*, *Praxillella tricirrata*, *Cirratulus parvus*, and *Amphitrite attenuata*, all of them new species from the south-eastern coast of Massachusetts.

Operculum of Spirorbis.‡—E. Elsler describes the structure of the operculum of *Spirorbis* and the modifications it undergoes when used as a brood chamber. For his investigations he used two species, *S. corrugatus* Montagu and *S. pusillum*. He finds that the operculum is derived from a modified gill-ray and consists of a simple stalked vesicle, the epithelium of which secretes a firm cuticle with localised secretion of lime. When the operculum functions as a brood-chamber the eggs lie, not, as is usually stated, within the ampulla, but between the hard cuticular layer and the epithelium which is retracted from it. During incubation the epithelium secretes a new cuticular layer. The eggs escape from the body cavity in some way as yet undetermined, and make their way into the brood chamber from without, possibly by the fissure through which the embryos make their exit, but this could not be demonstrated. The operculum may function thus several times in the life of an individual, but the repetition is attended by certain modifications. The processes of shedding and renewing the cuticular layer are common to all species of *Spirorbis*, and are not connected with reproduction. The functioning of the operculum as a brood-chamber is apparently a later character, made possible by these processes and acquired only by some species.

Neotropical Oligochæta.§—L. Cognetti de Martiis gives new records of several forms belonging to the families Megascolecidæ, Glossoscolecidæ, and Lumbricidæ. Amongst them are *Dichogaster tristani* sp. n., from San José de Costa Rica, found under the bark of a rotten tree, and *Anteoides desartsii* sp. n., from North Paraguay.

* Geol. Mag., iv. (1907) pp. 400–7 (1 pl. and 3 figs.).
† Proc. Acad. Nat. Sci. Philadelphia, lviii. (1906) pp. 501–8 (1 pl.).
‡ Zeitschr. wiss. Zool., lxxxvii. pp. 601–43 (1 pl. and 13 figs.)
§ Atti R. Accad. Sci. Torino, xlii. (1907) pp. 781–800 (1 pl.).

Structure and Classification of Echiurus chilensis.*— Philipp Seitz gives a detailed account of the structure of this form, and as a result of his investigation has established for it along with *Echiurus unicinctus* a new genus *Urechis*. The chief characteristic upon which this arrangement is based is the number of the segmental organs. *Urechis chilensis* has three pairs, and *U. unicinctus* two pairs. *U. chilensis*, though the more recently known, is to be regarded as the type, since for this species some characters are known which hitherto have not been demonstrated for *U. unicinctus*. The generic characters are fully tabulated in the memoir.

Pigment of Bonellia.†—R. Dubois extracted the pigment fluorochlorobonelline from the integument of *Bonellia viridis* by means of alcohol. It was experimented with by exposure to light. Violet and blue light did not sensibly destroy the green matter nor diminish its dichroism (nor probably its fluorescence). White light decolorises it. Green, yellow, and red gave slight decoloration. Decoloration was rapidly provoked by oxygenated water, but not by reducing agents. In darkness the solution is not altered. It is regarded as probable, in *Bonellia*, as in other green animals, that light increases cutaneous respiration. Some experiments with *Eulalia clavigera* are also described, in which it was found in excess of light to emit a rose pigment, probably as a defence from an excess of oxidation.

Chætognatha.‡—R. T. Günther gives an account of the Chætognatha with a view to demonstrating that, as far as our present knowledge goes, there are more numerous and cogent reasons for allying them with the Mollusca than with any other group, and that no organ of importance has been described in Chætognath anatomy which has not been closely paralleled by similar and indeed homologous organs among the Mollusca. The morphological characters he emphasizes in support of his contention are mainly these. The Chætognatha present the original bilateral symmetry of the Mollusca in its most perfect form. They resemble many Molluscs of undoubtedly primitive type in the absence of apparent segmentation. There is no evidence of a radula either in the Chætognatha or their ancestors. The buccal armature is like that of many Molluscs. The nervous system is of the Molluscan type. The genital cells grow within a follicular epithelium, and upon stalks. The two pairs of openings from the perigonadial cavity to the exterior are believed to be the homologues of two pairs of ducts in primitive Mollusca. The "hood" may be regarded as homologous with the Cephalopod circumoral "foot," and the preoral ciliated ring with the "velum." The Chætognatha, the author claims, may fairly be regarded as the living adult representatives of the phyletic stage indicated by the veliger larva. A scheme of classification representing this view is appended.

* Zool. Jahrb., xxiv. (1907) pp. 322–56 (3 pls.).
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 654–5.
‡ Quart. Journ. Micr. Sci., li. (1907) pp. 357–95 (10 figs.).

Platyhelminthes.

Opisthorchis felineus Riv. in Man.*—P. Verdun and L. Bruyant record a case at Tonkin in which hundreds of *Clonorchis sinensis* Cobb occurred in the liver and duodenum of a man from Annam. Amongst these were found seven specimens of *Opisthorchis felineus* Riv. This parasite has already been recorded in man, but the association here noted is altogether new.

Classification of the Bipalidæ.†—J. Müller supplements v. Graff's monograph by supplying particulars regarding the copulatory apparatus of the Bipalidæ. Since the publication of this monograph nineteen new species have been described—two of them in the present paper—and these have been incorporated in a table for the determination of species, which is also given.

Incertæ Sedis.

Researches on the Pterobranchiæ.‡—A. Schepotieff continues his account of the anatomy and histology of *Rhabdopleura normani* Allman. In the present paper he deals with the various types of buds, e.g. sterile, regenerated, and normal; the structure of the tube is described, and some account of the beginning and mode of spreading of the colony is given, but material to illustrate this appears to be very difficult to obtain.

Echinoderma.

Spicules of Synapta and Auricularia.§—W. Woodland, continuing his studies on spicule formation, has investigated the morphogenesis of the plate-and-anchor spicules of *Synapta inhærans* and *S. digitata*, and the part played by the living tissues of the organism in their production. Each spicule consists of two parts, the anchor and the plate, quite separate from each other. The first sign of the spicule is the multiplication of the nuclei of the dermal epithelium at one point to form a syncytium. A calcareous granule is deposited on the internal aspect of the syncytium, and elongates to form the shaft of the anchor. Six to ten nuclei migrate to the internal side of the shaft, and give rise to the plate. The disposition of the spicules and the shape of the anchor are probably conditioned by the contractions of the body-wall, but no physiological explanation of the association of anchor and plate has been arrived at.

The results gained in regard to the wheel spicule of the Auricularia larva differ considerably from those published by Chun. In this case also the spicule appears first as a granule in a syncytium, but the scleroblasts retain their individuality to some extent. The spicule becomes disk- and then cup-shaped, develops spokes as outgrowths from the margin, and finally becomes the felly of the adult wheel. The extension

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 704–5.
† Zeitschr. Wiss. Zool., lxxxvi. (1907) pp. 416–45 (2 pls.).
‡ Zool. Jahrb., xxiv. (1907) pp. 193–238 (7 pls.).
§ Quart. Journ. Micr. Sci., li. (1907) pp. 483–502 (2 pls. and 6 figs.).

of the scleroplasm is determined by the growth of the spicule itself. The heavy wheel and globe spicules weight the lower extremity of the larva, and determine the position it assumes in the water.

North Pacific Holothurians.* — C. Lincoln Edwards describes a collection from the North Pacific coast of North America. Eleven species are dealt with, their recorded habitats are enumerated, and a note of the literature bearing upon them is appended. Only one new form occurred in the collection, *Chirodota albatrossi* sp. n. In many respects it resembles *C. lævis* Fabr., but the presence of rods in the anterior part of the body-wall, the greater size of the body, and the larger number of wheel-papillæ constitute differential characters marking a new species.

Memoir on Antedon.†—H. C. Chadwick provides a memoir on this animal, in which he discusses the external characters, skeleton, muscles, ligaments, sacculi, digestive system, blood-vascular or lacunar system, cœlom, chambered and axial organs, water-vascular system, nervous system, and genital organs. Notes are also given on development, regeneraton, and on parasites.

Studies in Spicule-formation.‡—W. Woodland, in a series of papers, deals with the scleroblastic development of the spicules in Ophiuroidea, Echinoidea, in the genera *Antedon* and *Synapta*, in some Mollusca, and in one genus of Colonial Ascidians, viz. *Leptoclinum*.

Cœlentera.

New Tropical Cœlenterate.§—D. Pedaschenko describes an interesting Cœlenterate which he found upon the south-west coast of Java. It is from 1–1·5 mm. long and has complicated outgrowths. The real body consists of an upper oral end and of an aboral funnel with a knob-shaped sense-organ at the end. The oral region is laterally compressed, it carries two pear-shaped tentacle sheaths from which arise on each side two tube-shaped main branches. These are forked, and each limb ends in a vertically placed elliptical body. Only one of the specimens secured was active, and it swam with the oral pole directed upward. The structure is that of a Ctenophore, resembling *Cydippe*; swimming plates are absent, and on this account a special order is formed for it, viz. Actenæ. The species is named *Dogielia malayana*.

Variation in the Tentacles of Halocordyle cooperi Warren.‖—E. Warren has made a preliminary investigation on this subject. There is considerable variation in the arrangement of the capitate tentacles, but as the hydroid is comparatively rare sufficient material for a strict

* Proc. U.S. Nat. Museum, Washington, xxxiii. (1907) pp. 49–68.
† Liverpool Marine Biol. Committee Memoirs, xv. (1907) pp. 1–47 (7 pls.).
‡ Quart. Journ. Micr. Sci., li. (1907) pp. 31-43 (2 pls.); pp. 45–53 (1 pl.).
§ Trav. Soc. Imp. Nat., St. Pétersbourg, xxxvii. (1906), 26 pp., 3 pls. See also Zool. Centralbl., xiv. (1907) pp. 65–8.
‖ Annals Natal Govt. Museum, i. (1907) pt. 2, pp. 209–13.

analysis has not been obtained. Forty-two colonies were dealt with, and the results of the investigation are thus summed up. The oral verticil of four capitate tentacles tends to be constant, except in a few cases where all the tentacles were irregularly scattered. The variations in symmetry show how easily *H. cooperi* could have descended from a Pennarian ancestor, where the capitate tentacles are present in considerable number, and are quite irregularly scattered. An important point to consider is whether the distribution of symmetry in a population throws any light on the steps by means of which this symmetry was acquired. It may be assumed that symmetry of this nature could not easily be acquired by imperceptible steps: it would more readily be acquired by larger steps, or in other words by discontinuous variations. The amount of material was not sufficient to indicate whether locality or sex has any effect on the arrangement of the tentacles.

New Hydroid Genus from Natal Coast.* — E. Warren describes *Parawrightia robusta* g. et sp. n., which has been found at several places on the Natal coast. It is not very common; it occurs attached to seaweeds and sponges in the rock pools near the low-water line. The general appearance of the colony is like that of *Perigonimus*; the endoderm of the hydranth is red, as in several species of that genus, but the reproductive bodies are fixed gonophores, whereas in *Perigonimus* free medusæ are produced. On the whole it appears to come nearer to *Wrightia*, although distinct also from that genus. The name *Parawrightia robusta* is proposed to indicate the relationship. An account is added of a supposed Schizophyte occurring in the gonophores.

Porifera.

Factors in Production of Spicules.†—W. Woodland offers some preliminary considerations on this subject. He defines a spicule as a "hard, crystalline or colloidal deposit, of more or less extended and often definite and complex form, always possessing curved surfaces and never plane facets, formed initially within a cell or a cell fusion, and whose subsequent growth, which may be intra- or extra-cellular, is due either solely to the activity of the mother-cell or cells and its or their division-products if formed, or also partly to the activity of cells not derived from the original mother-cell or cells." A considerable body of argument is adduced, showing that we are "for the present justified in declining to entertain the hypothesis of the inheritance of spicule forms." Three factors in their production are conceivable: (*a*) The gross mechanical factor, or the shaping of a structure due either to actual contact with surrounding objects, or to the configuration of the secreting substance; (*b*) the influence at a distance—actio in distans—of different parts of the organism on the scleroplasm; and (*c*) the factor which produces crystallomorphs. These three are in turn considered. While it is admitted that prolonged investigation is still necessary before we can hope to interpret in a satisfactory manner the

* Annals Natal Govt. Museum, i. (1907) pt. 2, pp. 187–208 (2 pls.).
† Quart. Journ. Micr. Sci., li. (1907) pp. 55–79.

shapes of spicules, it is recognised that concerning factor (*c*) there exists a sufficient number of facts to indicate that it is mainly to be relied on in conjunction with factors (*a*) and (*b*) for our future comprehension of spicule forms. Factor (*a*) in all its aspects is but a subsidiary one, where complicated forms of spicules are concerned. · Little can be said regarding factor (*b*).

Protozoa.

New Sporozoon Genus from Nervous System of Cephalodiscus.*—W. G. Ridewood and H. B. Fantham describe *Neurosporidium cephalodisci* g. et sp. n., which occurs in the nervous layer of the ectoderm of *Cephalodiscus* (*Idiothecia*) *nigrescens* Lank., a large form dredged by the 'Discovery' in the Antarctic Ocean. In this new genus the trophozoite segments into uninucleate pansporoblasts, each of which enlarges and becomes a spore morula. This gives rise to many small spores, and a residual protoplasmic mass containing nuclei. The new genus is placed in a new section (Polysporulea) of the Haplosporidia.

Fresh-water Rhizopods.†—S. Awerinzew gives a systematic account of the Rhizopoda Testacea, with a complete synonymy and Table for species determination. To the systematic part, which also includes descriptions of new species, is prefixed an account of the general morphology and physiology of fresh-water Rhizopods, which contains some new points. Little importance is attached to the zones of the protoplasm; they depend on different chemical and physical conditions, and their number and arrangement vary in the same species. The so-called excretory granules consist of calcium phosphate. Rhumbler's phæosomes are not transformed into the shell layers. Amongst the protoplasmic inclusions are found masses of glycogen granules which are utilised during reproduction. In the biophytic bacteria found in *Pelomyxa*, the author sees food-stuffs simply; they exhibit various stages of digestion.

On the same ground the Zoochlorellæ in the plasma of Rhizopods are to be regarded as food materials; the term symbiosis is not applicable. There is a chapter on the reproduction of Rhizopods in which the life-cycle of various forms is described. An interesting point regarding the skeleton of the Rhizopoda Testacea is that on the whole it is larger in the forms occurring within the polar circle than in those of temperate zones.

Life-cycle of Herpetomonas from Culex pipiens.‡—W. S. Patton supplies some interesting facts in the life-history of a *Herpetomonas* from *Culex pipiens*. There is a stage in the larva of the mosquito which is very similar in form to the Leishmann-Donovan body, and which multiplies in a similar manner. In the pupæ, "rosettes" are formed and in some cases flagellation has taken place. In the adult mosquitos the parasites are elongated spindles with oval macro-nuclei and rod-shaped

* Quart. Journ. Micr. Sci., li. (1907) pp. 81–100 (2 pls.).

† Trav. Soc. Imp. Nat., St. Pétersbourg, xxxvi. (1906) 259 pp., 5 pls. See also Zool. Centralbl., xiv. (1907) pp. 60–2.

‡ Brit. Med. Journ., 1907, pp. 78–80 (2 figs.).

micro-nuclei lying between them and the anterior ends from which long wavy flagella protrude. The complete cycle is spent in the insect host and has no connection with any blood parasite. The early stages and their mode of development, together with the constant anterior position of the blepharoplast and the absence of the fully developed undulating membrane, suggest that the parasite is distinct from the Trypanosomata. There is at present no evidence of a sexual cycle or of the infection affecting the offspring. Some notes are also given upon certain stages in the life-cycle of a species of *Crithidia* found in a small water-bug.

Gregarines of United States.*—Howard Crawley supplies a third contribution on Polycystid Gregarines, all of which appear to have been found within the State of Pennsylvania. Leidy's *Gregarina achetæ-abbreviatæ* from the common cricket is re-described and figured, and several new species, mostly from Orthoptera, are recorded and described.

Amœbæ in Abscesses.†—P. Verdun and L. Bruyant describe cells resembling *Amœba coli* in the pus from two malar abscesses in man. No bacilli could be demonstrated, but in smears curious polynucleated elements, some of which were 50 μ in diameter, were observed.

* Proc. Acad. Nat. Sci. Philadelphia, lix. (1907) pp. 220–8 (1 pl.).
† C.R. Soc. Biol. Paris, lxiii. (1907) pp. 161–3.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Affinity of Colouring-matter of Blood and Chlorophyll.*—M. L. Marchlewski claims to have discovered a new proof of the affinity of the colouring-matter of blood and chlorophyll. The success attained by Laidlaw, Zaleski, and Forscher in the production of hæmin from hæmatoporphyrin, and of an iron compound of the formula $C_{34}H_{36}O_4N_4FeCl$ from mesoporphyrin, together with the complete agreement of character in the porphyrin of blood and phylloporphyrin, suggested to the author that phylloporphyrin would give a similar iron compound to that derived from hæmin. By proceeding in a manner analogous to that pursued by Zaleski in his experiment, the author has been successful in producing such a compound, and it so strongly resembles that derived from hæmin that it may be regarded as additional proof of the affinity of the colouring-matter of blood and of chlorophyll.

Analogy of Plant and Animal Cell-structure.†—M. v. Derschau has studied *Fritillaria imperialis* and *Lilium Martagon* with special reference to the analogy of the cell-structure of plants and animals. The author is of opinion that the development of the definitive nucleus from the linin plexus is due to the transformation of linin into chromatin, whereby another substance, "chromoplasma," appears in the nuclear body. The repeated nuclear and cell-division in plants indicates that regeneration of the hereditary substance must take place, and this must be at the expense of the linin, which in its turn is renewed at the expense of the surrounding cytoplasm. Deficiency of chromatin may so influence the nuclei of adjacent tissues that they will supply chromatin direct to the deficient tissues. Spindle-formation is associated with an extranuclear centrosphere, which contains the archosomes; the latter are of especial importance in the orientation and transport of the chromosomes. The centrosphere is amœboid, and its morphological transformation during the activity of the archosomes strongly reminds one of an *Amœba*.

Hybridisation and Germ-cells of Œnothera.‡—R. R. Gates continues his investigations upon *Œnothera* mutants, and finds that there are 20–21 chromosomes in plants of the *Lamarckiana* hybrid, whilst in pure *O. Lamarckiana* and *O. lata* there are 14 chromosomes, the reduced

* Bull. Internat. Acad. Sci. Cracovie, ii. (1907) pp. 57–9.
† Bot. Centralbl., xxii. (1907) pp. 167–90 (1 pl. and 2 figs.).
‡ Bot. Gazette, xliv. (1907) pp. 1–21 (3 figs.).

number being 7. There is doubt as to the origin of the heterochromosomes, which are present in all the reduction divisions, and until this point is settled, no significance can be attached to them. In the telophase of the heterotypic mitosis in the pollen-mother-cells of the *Lamarckiana* hybrid, the chromosomes are in tetrads. In the homotypic mitosis of *O. Lamarckiana*, and in the somatic mitoses, the chromosomes are two-lobed in the telophase. The tetrad appearance in the first case is probably due to the same lobing of the bivalent chromosomes of the latter case.

Structure and Development.

Vegetative.

Development of Pinnate Leaves.*—F. T. Lewis has studied the development of the pinnate leaves of the rose, blackberry, etc., and emphasises the primary distinction between the basipetal and basifugal types of growth. The author prefers, however, to separate the rose from the basipetal class of leaves, and to classify it as "stipular"; he agrees with Trecul and Lubbock in regarding the rose stipules as of earlier growth than the lateral leaflets. In cases where relatively simple leaves occur on plants which bear lobed or compound forms, there appears to be an arrest of development followed by expansion, or expansion before completion of the embryonic stage. The occurrence of simpler leaves near cotyledons, bud-scales, and sepals may be the outcome of rapidity of growth.

Microcycas calocoma.†—O. W. Caldwell contributes a second paper on this genus with special reference to its habitat and morphology. In Western Cuba small and widely scattered groups of *Microcycas calocoma* are to be found. The adult plant reaches the greatest height and circumference yet attained by the indigenous Cycads of the Western Hemisphere. The stem is straight or branched, and the ovulate cone is the largest known, resembling that of *Zamia*. Unbranched vascular bundles pass up the stalk of the megasporophyll; they then anastomose, finally branching repeatedly. The staminate cone is long and slender, having numerous sporangia on the abaxial side of its sporophylls, but there is no grouping into sori. In the male gametophyte eight body-cells and sixteen sperms are formed, and each body-cell has two large blepharoplasts. The female gametophyte is often lobed and may have over 200 archegonia, which develop on any part of the surface or even in the endosperm. Many embryos are formed, the suspensor being long and coiled spirally so as to press the embryo-tip against the endosperm. There are three to six cotyledons. *Microcycas* is the most primitive Cycad yet described.

Anatomy of Monocotyledons.‡—C. Queva, who recently published his investigations upon the tuberous Uvularieæ, now gives the results of his studies of the rhizotomous members of the group. The two genera studied by the author were *Uvularia* and *Tricyrtis*. The characters of

* Amer. Nat., xli. (1907) pp. 431–41 (4 figs.).
† Bot. Gazette, xliv. (1907) pp. 118–41 (2 pls. and 14 figs.).
‡ Bot. Centralbl., xxii. (1907) pp. 30–77 (49 figs.).

Uvularia recall those of *Gloriosa* and *Littonia*, but they are less specialised than those of the latter genera. In place of a tubercle there is a rhizome and the aerial stem is upright, slender, and short as contrasted with the elongated leafy stem of *Gloriosa* and *Littonia*. Corresponding with these differences there are anatomical differences. Although there are two kinds of leaf-traces in *Uvularia*, they are less clearly defined than in the tuberous Uvularieæ. *Tricyrtis hirta* is of a still simpler type. It is a geophilous plant with a branched rhizome; the stem and leaf are of the simplest anatomical form; and there is only one kind of leaf-trace which traverses the stem in the typical manner. It would seem that *Tricyrtis* is nearer than *Uvularia* to the ancestral type of the group. The tuberous Uvularieæ are thus regarded as very highly specialised Liliaceæ, the rhizotomous Uvularieæ are of intermediate rank, while *Tricyrtis* is lowest in the series. The author is of the opinion that in the present state of our knowledge it is undesirable to lay too much stress upon the usual definitions of primary and secondary tissues, since the characters of such tissues are not constant.

Reproductive.

Microgametophyte of the Podocarpineæ.*—E. C. Jeffrey and M. A. Chrysler have studied the male sexual generation of the Podocarpineæ with special reference to their phylogeny. The genera *Podocarpus* and *Dacrydium* show proliferation of the two prothallial cells, which in some cases is accompanied by similar proliferation of the generative cells, a circumstance which has hitherto not been observed in any Gymnosperm. The proliferation of the prothallial cell has, however, been observed in the Araucarian genus *Agathis*. There is no reason to suppose that such proliferations are a primitive feature. The general microgametophytic development in the Podocarpineæ and the Araucarineæ points to a common ancestral stock allied to the Abietineæ. The authors regard it as not improbable that the Podocarpineæ and Araucarineæ may be more nearly allied than has hitherto been supposed.

Pro-embryo of Pinus Laricio.†—N. J. Kildahl has studied the embryo of *Pinus Laricio* with special reference to the development of the walls. The author finds that the cross-walls are formed in the usual way, and come a little in advance of the vertical walls. The vertical walls are formed by secondary fibres from the nuclei of the respective tiers. The formation of the first cross walls and the first vertical walls is connected with the division of the first four free nuclei. The second division in the basal part of the egg may occur in either tier. The last division of the four nuclei is not always simultaneous.

Pollen-formation in Cucurbitaceæ.‡—J. E. Kirkwood has studied the pollen of *Fevillea cordifolia*, *Micrampelis lobata*, *Cyclanthera explodens*, and other members of the Cucurbitaceæ. The development of the sporogenous tissue and the pollen agrees with that of other members of the family. The pollen-mother-cells are especially interesting owing to

* Amer. Nat., xli. (1907) pp. 355–64 (5 figs.).
† Bot. Gazette, xliv. (1907) pp. 102–7 (2 pls.).
‡ Bull. Torrey Bot. Club, xxxiv. (1907) pp. 221–42 (5 pls.).

the presence of darkly staining, rod-like bodies in the cytoplasm, which are apparently of kinoplasmic origin, and appear to be connected with mitosis; their function has not yet been fully determined. The cytoplasm is distinctly fibrillar, but this aspect disappears when the spindle is formed. The spindle originates partly from the linin of the nuclear network, but mostly from the fibres which surround the nucleus as the wall dissolves. It is narrow and pointed with spreading fibres. The chromatin is at first inconspicuous, but later on forms paired masses which are regarded as chromosomes. Synapsis is a normal phenomenon, and the separation of the chromosomes is of the heterotype character. The reduced number of chromosomes is sixteen. The character of the chromosomes rendered it impossible to make out the features of the second mitosis, but it is essentially different from the first.

Embryology of Rhizophora Mangle.*—M. T. Cook has studied the embryology of *Rhizophora* and finds that only one out of four ovules is fertilised. There are probably four megaspores. Completion of the embryo-sac is accompanied by disintegration of the nucellus, and later on the inner integument and the endosperm likewise disintegrate. The embryo has a distinct suspensor and has three periods of growth: (1) first growth of cotyledons; (2) growth of the hypocotyl; (3) second growth of cotyledons. During the first period part of the embryo and endosperm are forced out of the embryo-sac into the ovary chamber, while during the second period the cotyledons are much modified for the purpose of absorption. During the third period the cotyledons elongate, and their point of union with the hypocotyl extends beyond the apex of the ovary.

Physiology.

Nutrition and Growth.

Ascent of Water in Trees.†—A. J. Ewart continues his investigations upon the ascent of water in trees, and is of the opinion that continuous ascent is only possible in living wood, for even without mechanical blocking of the vessels the power of conduction is lost rapidly after death. The author concludes that in tall trees the living cells maintain the conditions for ascent of water, and only in trees over 20–50 m. in height is pumping action necessary. No vessels appear to run as open channels from end to end of the tree. In the trees used for experiments there were no continuous suspended water columns or high internal tensions, and this fact, coupled with the high total resistance, seems to indicate that the resistance is overcome locally, and not by enormous tension from above or pressure from below. The author's experiments show that the ascent of water is a vital problem, since it is dependent upon conditions only possible in living wood.

Self-sterility of Flowers.‡—L. Jost has investigated self-sterility of the flowers of *Corydalis cava*, *C. lutea*, *Secale cereale*, *Lilium bulbiferum*, *Hemerocallis flava*, *Cardamine pratensis*, and a few of the Leguminosæ.

* Bull. Torrey Bot. Club, xxxiv. (1907) pp. 271–7 (2 pls.).
† Proc. Roy. Soc., lxxix. (1907) pp. 395–6.
‡ Bot. Zeit., lxv. (1907) pp. 77–117 (1 pl.).

The sterility of *Cytisus Laburnum* is due to the fact that the pollen cannot germinate unless the stigma has suffered mechanical injury; when this occurs, self-fertilisation is rendered possible. It is probable that many other Papilionaceæ behave in a similar manner. In *Corydalis cava*, the stigma must be injured before the pollen can germinate, but the tube only penetrates a very short distance. In *Secale* and *Lilium bulbiferum*, the pollen of the same flower may germinate, but does not usually fertilise the ovules. Generally, in all cases of self-pollination in the examined species, the growth of the pollen-tube ceased before fertilisation, but there is no reason for supposing this to be the result of lack of sexual affinity. Experiments on various substrata show that pollen will germinate under conditions which will not support its further growth: the tube starts growth, and may even penetrate the conducting tissue for some distance, but unless on its own particular substratum, it does not reach the gynœcium. From the negative results of the experiments, there is no reason for supposing that pollen cannot be nourished on an artificial substratum; it can only be supposed that up till the present time, the nutrient solutions have been lacking in some substance which is necessary to bring the pollen-development to perfection. This unknown substance is not the protoplasm itself, since the pollen-tube and the cells of the conducting-tissue have unbroken cell-walls. The substance must be soluble and diffusible, and must be different in different plants. In closely related species and in different forms of heterostylic flowers, a quantitative difference in concentration would be sufficient, but in self-sterile flowers there must be a qualitative difference. Whether the retardation of growth is due to identity between some material in the pollen-tube and in the conducting-tissue, or whether some difference in material promotes the growth of the pollen-tube, cannot at present be decided.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Philippine Ferns.*—H. Christ publishes a list of new or imperfectly known ferns of the Philippine Islands, founded on collections made by Loher, Copeland and Merrill. He enumerates 111 species, among which are 27 new species with 3 new sub-species and 9 new varieties. Many critical notes are inserted; and the value of the secondary leaves in separating the species of *Stenochlæna*, and as indicating the Asplenoid ancestry of the genus, is pointed out.

The same author† gives a classified list of the Philippine species of *Dryopteris*, not intended to be complete, but founded upon all available material in the herbarium of the Bureau of Science at Manila, and the collections of Copeland and Loher. The genus *Dryopteris* is limited in the sense of Christensen's *Index Filicum*, that is, excluding *Pleocnemia* and *Sagenia*, and treating only *Lastrea* (including *Phegopteris*) and

* Philippine Journ. Sci., Manila, ii. (1907) pp. 153–88.
† Tom. cit., pp. 189–217.

Nephrodium proper (including *Goniopteris*, *Mesochlæna*, and *Meniscium*). The Philippines are particulary rich in these species. In *Nephrodium* proper, nowhere else is there such diversity of forms with special characters, for example, pinnæ attenuated toward their bases, lower pinnæ deflexed, lower pinnæ degenerating into auricles gradually or abruptly. These characters are rather rare in other parts of the world. In the Philippines also is an interesting tendency to "insular" reduced types, rare elsewhere; for example, in *D. canescens*; but the variations do not as yet appear to be constant. Analogous variations are found in other genera; for example, under *Leptochilus heteroclitus*, *Pteris ensiformis*, *P. heteromorpha*. Analogous insular forms in the West Indies are found in *Polystichum*, *Fadyenia*, *Sagenia*, and especially in *Dryopteris reptans*. The wonderful variations of *Dryopteris canescens* into acrostichoid forms in the Philippines strengthen the view as to the possible affinity of *Leptochilus*, *Gymnopteris*, *Polybotrya*, *Egenolfia*, *Stenosemia*, and *Cœnopteris* with *Aspidium*. The contention that *Acrostichum* is only *Aspidium* with reduced fertile pinnæ is much supported by the parallel instance. The author's list comprises 78 species, amongst which are 17 species and 2 sub-species new to science.

North America Ferns.—A. Hans * describes and figures some variable sporelings of *Lomaria spicant*. W. N. Clute † published some notes upon the struggle for existence manifested by ferns in the tropics, especially Jamaica. They are very abundant—on the ground, climbing or trailing over trees, epiphytic on the branches, creeping on the trunks. Sometimes they occupy sun-baked hillsides, where nothing else will grow; for example, thickets of *Gleichenia*, *Gymnogramma* powdered over with a waxy coating, *Notholæna* clothed with scales. One species of *Acrostichum* sends up a scaly cord-like root-stock upon a tree-trunk to a height of 20 feet before emitting its great fronds. He also discusses ‡ the case of *Osmunda cinnamomea*, which normally fruits in the spring, but in Florida and the southern states has a second fruiting season in the autumn. He describes § *Pteris aquilina pseudocaudata* an aberrant form of the bracken common in the southern states. He continues his checklist ‖ of the North American Fernworts from *Nephrolepis* to *Phegopteris*. A. C. Dalgity ¶ discusses the value of the common brake-fern as a food, and describes some successful experiments made with the young leafy shoots as an article of cooked food. This is supplemented by an anonymous note ** upon the esculent properties of some other ferns, notably the farinaceous medulla of the trunks of a few species of *Cyathea* and *Alsophila*.

Ferns of the Black Forest.††—A. Geheeb publishes some notes on ferns from the Schwarzwald of Baden. He records and describes a very rare monstrosity new to the district, *Asplenium trichomanes* var. *multifidum* Moore, and compares it with var. *microphylla* and var. *lobato-crenata*. He also records the occurrence of *Woodsia ilvensis* from a

* Fern Bulletin, xv. (1907) pp. 33–4.
† Tom. cit., pp. 34–8.
‡ Tom. cit., pp. 39–40.
§ Tom. cit., pp. 43–4.
‖ Tom. cit., pp. 45–9.
¶ Tom. cit., pp. 41–3.
** Tom. cit, pp. 50–1.
†† Allgem. Bot. Zeitschr., xiii. (1907) pp. 127–30.

second station in the Schwarzwald. Thirdly, he describes forking of the frond of *Blechnum spicant* and *Asplenium filix-femina* in the same region.

Apogamy in Marsilia.*—E. Strasburger has investigated the question of the production of embryos in *Marsilia* without fertilisation. Some of the sporocarps which he germinated had been in herbaria for more than thirty years. In some species, as *M. Drummondi*, the megaspores produce prothallia and embryos almost as abundantly in the absence of microspores as in their presence. Embryos often develop from unfertilised eggs, and their nuclei have 32 chromosomes, the $2x$ or sporophyte number. Some megaspores have nuclei with $2x$ chromosomes, reduction of the chromosomes having failed to take place; and the same phase is maintained throughout the life-history, the prothallia, eggs, and embryos all having nuclei with $2x$ chromosomes. But in the same species reduction also occurs, so that prothallia and eggs have nuclei with the x or gametophyte number. In forms which produce apogamous embryos, microsporogenesis is usually abnormal, spores of $2x$ phase being produced; but sometimes normal reduction of chromosomes takes place. The nuclei of the x and $2x$ prothallia and eggs are distinguishable by size, the $2x$ sort being larger. Strasburger regards the $2x$ egg as purely vegetative, and therefore employs the word apogamy and not parthenogenesis. But he would use the latter term in case an egg with x chromosomes were to develop an embryo without fertilisation. He also describes the development of the spore walls.

Apogamy in Nephrodium.†—S. Yamanouchi gives a preliminary account of his cytological studies on apogamy in *Nephrodium molle* Desv. He treats his subject under the headings: Mitoses in the sporophyte; spermatogenesis; oogenesis and fertilisation; apogamy; and states his conclusions as follows. (1) The nuclei of the prothallia contain 64 or 66 chromosomes, the reduced, gametophytic, or x number. The nuclei of the gametes contain the same number. The fusion nucleus in the fertilised egg presents 128 or 132 chromosomes, the unreduced, sporophytic, or $2x$ number, which keeps unchanged until it is reduced during sporogenesis. Consequently it follows in the normal life-history of *Nephrodium* that the gametophyte contains the x number of chromosomes and the sporophyte the $2x$ number, and that sporogenesis and fertilisation are the periods which mark the initiation of the two distinct generations. (2) The nucleus of a prothallial cell with the x number of chromosomes (64 or 66) sometimes becomes directly the nucleus of a sporophyte, apogamously produced; so that the x number of chromosomes continues through the whole life-history in the apogamous sporophyte. This fact does not seem to affect the fundamental idea that the alternation of generations is marked by the difference in the number of chromosomes in the normal life-history, but is simply an abnormal case of secondary importance. Still it must be admitted that in the case of apogamy at least the number of chromosomes is not the only factor which determines the character of the sporophyte and gametophyte.

* Flora, xcvii. (1907) pp. 123–91 (6 pls.). See also Bot. Gazette, xliv. (1907) pp. 70–1.

† Bot. Gazette, xliv. (1907) pp. 142–6.

Polyspermy in Ferns.*—W. L. Woodburn describes and figures a remarkable instance of polyspermy in *Onoclea struthiopteris*, some prothallia of which were supplied to him which had been preserved ten hours after the introduction of spermatozoids. In one egg-cell no less than seven spermatozoids were counted, entirely within the nuclear membrane and occupying the central part of the nucleus. Nothing in the appearance of the egg, either in the cytoplasm or nucleus, indicated an abnormal condition of the egg or the egg-nucleus. The chromatin network was broken up and irregularly massed, but it could hardly have been otherwise after the entrance of so many spermatozoids. Besides the seven spermatozoids which entered the egg-shell there were three others lying in the concavity just above it.

Studies on the Ophioglossaceæ.†—D. H. Campbell, during a recent visit to Ceylon and Java, began to study the germination, development and structure of the Ophioglossaceæ, and, having secured and examined much material, publishes his results, which, put briefly, are as follows. (1) The spores of *O. moluccanum*, when sown artificially, germinated freely, but not beyond the stage of four cells, through absence of association with the mycorhizal fungus. The spores of *O. pendulum* germinated more slowly, and where associated with the fungus produced a prothallium of 12–13 cells. (2) Chlorophyll was found in *O. moluccanum*, but not in *O. pendulum*. (3) Adult natural prothallia of both these species were found, and also of another species undetermined. (4) The gametophyte is subterranean and normally lacks chlorophyll; it is radial in structure. It is short-lived in *O. moluccanum*, but larger in *O. pendulum* and capable of unlimited reproduction by means of detached buds. (5) The antheridium agrees with the description given by Lang and Bruchmann; the spermatozoids are very large and in development resemble those of *Equisetum*. (6) The archegonium resembles that of Marattiaceæ; two neck-canal cells may be present, and there is always a division of the canal-cell nucleus. A ventral canal-cell was demonstrated in *O. pendulum*. (7) The basal wall of the embryo is probably transverse in most cases, but varies in *O. pendulum*. The foot, derived from the whole hypobasal half of the young embryo, varies in degree of development. (8) There are three types of the embryo. In that of *O. moluccanum* leaf and root only are developed. In that of *O. vulgatum* root and stem, with a late development of the foliage-leaf. In *O. pendulum* roots only. (9) The definite sporophyte in both *O. moluccanum* and *O. pendulum* is formed as an adventitious bud upon the root of the embryo sporophyte. (10) In *O. moluccanum* the tissues of cotyledon and primary root are continuous, and the structure of the axial vascular bundle is essentially the same throughout—collateral in leaf, monarch in root. The primary root of *O. pendulum* is diarch like the later roots. (11) The type of embryo in *O. moluccanum* is primitive and has its nearest analogy in Marattiaceæ and *Equisetum*, its growth being bipolar and itself perforating the gametophyte. (12) The nearest affinity of *Ophioglossum* is probably with Marattiaceæ, but probably a more remote

* Bot. Gazette, xliv. (1907) p. 227 (1 fig.).
† Ann. Jard. Bot. Buitenzorg., xxi. (1907) pp. 138–94 (11 pls.).

affinity is with the Equisetineæ. (13) An endophytic fungus is always present in Ophioglossaceæ, both in gametophyte and sporophyte; and in *O. pendulum* and *O. moluccanum* the sporophyte appears to be infected from the prothallium. (14) Under the name *O. moluccanum* Schlecht evidently three distinct species have been included. *O. intermedium* Hook is a good species.

Sporangium of Ophioglossales.*—L. L. Burlingame describes in detail the development of the sporangium of the Ophioglossales. In summing up his results he makes a compact statement in three parallel columns of what happens respectively in the three genera of Ophioglossales—*Ophioglossum*, *Helminthostachys*, *Botrychium*. This tabular statement serves to show the contrasts. He also sums up the features common to the three genera, namely: (1) the breaking down of the inner layers of the wall; (2) the penetration of a plasmodium, derived from the tapetal cells, among the sporogenous cells; (3) the failure of the mother-cells to contribute to the tapetal plasmodium; (4) the formation of resting nucleus after the first maiotic division; (5) the appearance in the spore-plasm of a phase of decreasing density followed by one of increasing density, the former possibly connected with the rapid growth of the young spore-coat (no data from *Botrychium*); (6) the spores rich in starch; (7) the tetrads in vacuoles of the plasmodium.

Bryophyta.

(By A. Gepp.)

British Moss Catalogue.†—The Moss Exchange Club have just issued a census catalogue of British mosses, the result of the combined effort of the members of the club to compile as complete a record as possible of the distribution of the 619 British species and their varieties throughout the 112 Watsonian vice-county divisions of Great Britain, and Praeger's 40 county divisions of Ireland. Explanatory notes are supplied by W. Ingham and H. N. Dixon, and these are followed by a table of the county divisions, with their reference and their boundary limits. The very numerous sources from which the catalogue has been compiled are duly set forth in detail, carefully arranged in geographical sequence, and provide an almost exhaustive record of the very scattered papers on British bryology and many manuscript lists.

New British Moss.‡—P. Culmann describes a new species found by W. E. Nicholson on the wall of a culvert at Amberley, in Sussex. In structure the plant approaches *Barbula rigidula*, but differs in habit, in which respect it approaches *Schistidium*. It appears to be a species of either *Barbula* or *Didymodon*.

British Hepaticæ.§—W. H. Pearson publishes an introduction to the British Hepaticæ as an incentive to a study of this group. He

* Bot. Gazette, xliv. (1907) pp. 34–56 (2 pls.).
† Census Catalogue of British Mosses. York: Coultas and Volans, 1907, 63 pp.
‡ Rev. Bryolog., xxxiv. (1907) pp. 100–2 (figs.).
§ Ann. Rep. and Trans. Manchester Micro. Soc., 1906 [1907] pp. 46–53 (1 pl.).

gives first a short history of the work done in the past, beginning with Dillenius' Historia Muscorum in 1741, and touching on the principal collectors. He mentions that the interesting herbarium of the American, Coe F. Austin, is now in the Manchester Museum. The author then describes in popular terms the general character of the Hepaticæ and their structure, under the headings: stem, leaves, texture of leaves, inflorescence, and perianth. Finally, he makes some remarks on their distribution and nomenclature, and offers to name specimens or assist any student in this branch of Botany.

Hepaticæ of Baden.*—K. Müller publishes the eighth and, for the present, the last of his papers on the Liverworts of Baden, the study of which he has been pursuing for the last ten years. When he first began his work, only 124 species as now recognised were known for Baden, and now there are 159. He divides the duchy into 11 districts, and gives the number of species recorded then, and now, from each, stating at the same time his belief that the work is by no means completed, but that the distribution of some of the species may yet be considerably enlarged. In the present paper he enumerates 104 species, giving new localities for each; of these, 8 species are new to Baden. The most interesting record is the Alpine *Frullania Jackii* Gottsche, at a height of 500 m. above sea-level, where it grew sparingly, in the neighbourhood of Murgthal with *F. Tamarisci*.

German Mosses.†—E. Prager collected mosses and hepatics in the Riesengebirge during the dry summer of 1904. Some of the bogs had dried up, and were easily accessible. Hence he was able to record new localities and new forms in a district which had been much explored by competent bryologists previously. *Fontinalis Prageri* Warnst. is a new species. C. Warnstorf ‡ gives a list of 31 mosses and hepatics collected by him during a day's excursion to Ludwigslust, a large grand-ducal park between Berlin and Hamburg. He describes a new variety of *Brachythecium rutabulum*.

Hybrid Moss-names.§—C. Warnstorf protests against Roth's having dropped the specific name of *Sphagnum crassicladum* on account of its mixed Graeco-Latin derivation, and points out that he maintains the equally objectionable *S. cymbifolium*, as indeed he is bound to do by the rules of nomenclature.

Austrian Mosses.‖—J. Glowacki concludes his report on the mosses of the Austrian protectorate, giving lists from 19 different localities. Among the species is one novelty, *Pseudoleskea illyrica*, allied to *P. atrovirens*, which is fully described. Lists are also given of collections of mosses made by Karlinski in Cajnica, Sarajevno, etc., and by Straka in the district of Foca.

* Beih. Bot. Centralbl., xxii., Abt. 2 (1907) pp. 241–54.
† Allgem. Bot. Zeitschr., xiii. (1907) pp. 122–6 (fig.).
‡ Tom. cit., pp. 130–1. § Tom. cit., pp. 131–2.
‖ Verh. k.k. Zool. Bot. Ges. Wien, lvii. (1907) pp. 223–44.

Sicilian Bryophytes.*—G. Zodda publishes his second contribution to the Bryophytes of Sicily. The district explored was that known as Nebrodi in the high valley of the Simeto and the Flascio, in the provinces of Messina and Catania. The soil is mainly composed of sand and siliceous cement of the Lower Miocene, and the habitats are: (1) pasture land; (2) rocks; (3) bogs and swampy soil; (4) streams; (5) trunks of trees. Of these the second and fifth were by far the richest. The author gives short lists of the species commonest in each. The pleurocarpi are more plentiful than the acrocarpi as regards quantity, and the perennial species predominate over the annual. Extraordinarily poor is the material of Hepaticæ, only four species being recorded. This the author attributes to the want of suitable habitats in the district examined. Eighty-three species of mosses are recorded, of which six new varieties are described by Roth.

North American Muscineæ.†—J. L. Sheldon publishes a list of all the hepaticæ known to occur in West Virginia, compiled from previous short lists and from specimens in his own herbarium and in that of the West Virginia Agricultural Experiment Station. So far as possible the habitat, locality, and collector's name, are given for the 59 species here recorded, and the list is preceded by some general remarks on species growing in certain localities.

J. M. Holzinger‡ has made a study of the Muscineæ of Washington and its vicinity, and publishes a list of all the species he has found. In despair of finding any real correspondence between the mosses recorded in local lists and the specimens deposited in the Washington Herbarium, he has himself placed in that herbarium a specimen of every species quoted, amounting to 139 mosses and 19 hepaticæ. The locality of each record is given in the list.

N. C. Kindberg § describes 32 new species and sub-species from various parts of the North American continent.

Muscineæ of French West Africa.‖—E. G. Paris reports on a further collection of mosses and hepaticæ, collected by M. Pobeguin, administrator of Timbo in Fonta-Djallon. This collection contains 12 new species, one of which belongs to *Levierella* and another to *Helicodontium*. Of the former genus only 2 species have been known hitherto, one occurring in the upper valley of the Ganges, and the other in Abyssinia. Of the 20 hitherto known species of *Helicodontium* only 4 have been recorded outside America. The present list enumerates 32 mosses and 5 hepaticæ.

Air Chambers in Hepaticæ.¶—C. R. Barnes and W. J. G. Land publish the first of a series of bryological papers, and the present contribution deals with the origin of air chambers. It was always supposed that the intercellular spaces in liverworts took their origin in the same manner as in vascular plants; and in 1879 Leitgeb ascribed the origin of the mucilage clefts and chambers of *Anthoceros* and *Dendroceros* to

* Malpighia, xxi. (1907) pp. 25–37.
† Bryologist, x. (1907) pp. 80–4.
‡ Tom. cit., pp. 85–92.
§ Rev. Bryolog., xxxiv. (1907) pp. 87–92.
‖ Tom. cit., pp. 93–9.
¶ Bot. Gazette, xliv. (1907) pp. 197–213.

cleavage, and this view has been quoted in all text-books. As regards Marchantiales, however, other views were held by both Hofmeister and Leitgeb. Leitgeb's views on the origin of the stomata of *Marchantia* are briefly and clearly given by Vines in the English edition of Sachs's Lehrbuch der Botanik 1882, Appendix p. 948, where the stomata are said to "appear originally as depressions in the surface, which arise by definite points (always situate where four cells meet), lagging in growth and so becoming overgrown by the adjacent parts." In 1904 the attention of the authors was attracted to some very young air chambers on a still very small receptacle of a species of *Fimbriaria*. A cursory examination showed that a re-investigation of the origin of the air chambers was needed, and the authors proceeded to obtain and examine as many of the Marchantiales as were easily obtainable, including species of *Riccia*, *Marchantia*, *Lunularia*, *Conocephalus*, *Dumortiera*, *Fimbriaria*, and *Plagiochasma*. The views of Leitgeb are fully discussed and criticised, and the conclusions of the present authors are stated as follows. The air chambers of Marchantiales arise invariably by the splitting of internal cell walls, usually at the junction of the outermost and first internal layer of cells. Thence, in one type, splitting proceeds outwardly and inwardly more extensively than laterally, and lateral enlargement of the chamber follows by growth; while in the other type expansion of the chamber is due to extensive inward splitting accompanied by growth. The origin of the air chamber is in all respects like that of intercellular spaces in the vascular plants.

Germination and Regeneration of Riella and Sphærocarpus.*—K. Goebel publishes some further remarks on these subjects. He shows that the peculiar wing of *Riella* is not a subsequent outgrowth from the midrib, but lies in the same plane as the germ-disk and springs directly from it; and when new shoots are regenerated after injury secondary germ-disks are first produced, and from them arise the new thalline shoots. In *Sphærocarpus* the spore produces a germ-tube, which becomes a multicellular cylinder with depressed apex, from one quadrant of which the vegetative point arises, while from two others arise the wings of the thallus. In adventive shoots the same phenomena occur. The formation of sex-organs is remarkably precocious, as Leitgeb has pointed out.

Regeneration in Mosses.†—J. Westerdijk has experimented on the following mosses with regard to regeneration: *Hookeria quadrifaria*, *Fissidens taxifolius* and *F. adiantoides*, *Tortula muralis*, *Funaria hygrometrica*, *Dicranella curvata*, *Ceratodon purpureus*, *Mnium undulatum* and *M. rostratum*, *Polytrichum commune*, *Catharinea undulata*, and *Aulacomnium palustre*. He removed portions of the plants from each pole, and as the result he found a growth of rhizoids and protonema took place, principally from the pole itself. Whether rhizoids or protonema arise depends on external factors; darkness and contact with firm bodies inciting the production of rhizoids, while light incites a protonema,

* Flora, xcvii. (1907) pp. 192–214 (figs.). See also Bot. Gazette, xliv. (1907) p. 72.

† Rec. Trav. Bot. Néerlandais, iii. (1907) pp. 1–66. See also Bot. Zeit., lxv. (1907) pp. 282–3.

regardless of whether the respective pole is basal or apical. The author finds, however, that if the basal pole be turned upwards it produces much more protonema than the apical pole in a similar position. The author concludes therefore that the power of regeneration at the basal pole is stronger than that at the apical pole, and he denies that mosses have true polarity, i.e. a distinct distribution of "organ-forming" material. A correlation exists between the growing terminal bud and the formation of protonema from rhizoids, inasmuch as protonema can only be formed if the terminal bud be removed or checked in its growth. After removal of the root-pole the formation of protonema takes place plentifully. Fruiting and sterile stems behave alike as regards regeneration.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Characeæ of the Balkans.*—J. Vilhelm calls attention to the scantiness of the Characeæ hitherto recorded for the Balkan States. Only twelve species had been made known for the region. He now adds seven new forms, which he describes. They were collected in Bulgaria, Montenegro, and the Athos Peninsula.

Halicystis and Valonia.†—P. Kuckuck has made a minute study of *Halicystis ovalis*, its outer and inner structure, reproduction, germination and development, mode of life, etc. His results are summed up as follows: *H. ovalis* is a complete, unicellular, multinucleate member of the Chlorophyceæ, which, with its basal portion, bores into the calcified crusts of *Lithothamnion polymorphum*. The chromatophores are without pyrenoids, but contain starch. Even during the formation of zoospores, which takes places in the upper part of the inflated cell, there is no separating wall; the protoplasm in the lower part of the cell remains sterile. In some individuals large macrospores and small microspores are formed, both of which bear two cilia at the apex, but no eye-point. The macrospores are neutral, the microspores very probably gametes. The zoospores issue through one or more holes. The groups are sometimes roundish, sometimes band- or ring-shaped. The same individual may go through as many as eight fertilisings; fertilisation occurring at the same time in all individuals of the same group, while escape of the spores also occurs at almost the same time. After each fertilisation, the holes close up and the empty spaces refill with chlorophyll.

Kuckuck in the same paper makes some interesting and valuable notes on three species of *Valonia*, *V. macrophysa*, *V. utricularis*, and *V. ægagropila*. They are composed of several to many cells, and each cell contains many nuclei. The chromatophores possess a large pyrenoid. *Valonia* is always attached externally to the substratum. Besides the daughter-cells and the swollen excrescences, not cut off from the main

* Hedwigia, xlvii. (1907) pp. 66–70.
† Bot. Zeit., lxv. (1907) pp. 139–85 (1 pl., and figs. in text).

thallus, there are also small and large hour-glass cells, which grow out to form unicellular haptera. In the formation of zoospores, an entire vesicle is fertilised. The zoospores which escape through numerous holes have a red eye-spot, and in *V. macrophysa* four cilia, in *V. utricularis* two. They are asexual, and germinate easily. The mass of zoospores is net-shaped. After fertilisation the vesicle goes to pieces.

Structure and Classification of the Siphonales.*—C. A. Bessey discusses this subject, and makes an attempt to arrange the cœnocytic algæ in accordance with the theory that they have been derived from multicellular filamentous algæ of the Ulotrichoid type, among the Confervales, where the segments of the filament are true cells, each having a single nucleus. Near to these are placed the Cladophoraceæ, in which the segments of the filaments are more or less elongated cœnocytes, each of which contains from one to many nuclei. The author considers that Cladophoraceæ, united with two or three other families, should form an intermediate group between the strictly cellular and the completely cœnocytic orders: an arrangement which is followed by Blackman and Tansley, and by Oltmanns. Siphoneæ and Siphonocladaceæ are not retained as two sub-orders. The Cladophoraceæ are regarded as having been derived from the Ulotrichaceæ, and have themselves given rise to two distinct phyla: (1) the *Vaucheria* series; and (2) the *Acetabularia* series. The evolutionary steps marked by different genera are shown in a diagram. The author acknowledges 18 pretty well marked families in Siphonales, of which 11 belong to the Algæ. A key to these 11 is given, followed by keys to the genera in each family and a short diagnosis of each genus.

Observations on Spirogyra.†—F. E. Fritsch and F. Rich publish the first of a series of studies on the occurrence and reproduction of British fresh-water algæ in nature. In the present paper they deal with *Spirogyra*, of which alga they have examined extensive material at various seasons from ponds situated mainly in the south of England. The authors present their results under the heads: The occurrence of *Spirogyra* in nature; the reproduction of *Spirogyra* in nature: and points of systematic interest. They summarise their results as follows: The species of *Spirogyra* which we have examined are either purely vernal or exhibit both a vernal and an autumnal phase with an intervening period of scarcity or complete disappearance: it seems possible that there is also a period of disappearance in mid-winter, but this is not certainly established. The autumnal re-appearance of certain species of *Spirogyra* is no doubt due to the influence of certain combinations of external factors causing a small number of zygospores to germinate; in the absence of these conditions there may be no autumnal phase. Abnormal meteorological conditions may bring about abnormal absence or occurrence of *Spirogyra*.

Reproduction takes place ordinarily in the vernal phase, and is most probably the result of certain periodically recurring combinations of factors, which vary for different species. A considerable number of

* Trans. Amer. Micro. Soc., xxvii. (1907) pp. 47–62 (1 pl.).
† Ann. of Bot., xxi. (1907) pp. 423–36.

data are advanced in support of this view. The nature of the stimulus causing vernal reproduction is probably an intensification of those conditions, which are liable to change in spring. Such intensification may exceptionally take place at other times of the year, and lead to reproduction at other times than in spring.

As regards the points of systematic interest, the authors confirm the view that *S. ternata* Ripart is only a form of *S. neglecta*, which they find is a very variable species. They figure and describe another form which appears to be new. In *S. varians*, which has been described by G. S. West as exhibiting frequently lateral conjugation, they have noticed only scalariform conjugation, though they have often found the species in the reproductive condition. On one occasion they found it doubled back and conjugating with itself. *S. affinis* is figured with both scalariform and lateral conjugation in the same filament; and other figures show the two types of conjugation in *S. longata*.

Fresh-water Algæ of the Great African Lakes.* — G. S. West publishes a lengthy and detailed report upon the fresh-water algæ, including phytoplankton of the third Tanganyika Expedition conducted by W. A. Cunnington (1904–5). The collections were of an extensive nature, and consisted largely of plankton obtained from the three great lakes, Nyasa, Victoria Nyanza, and Tanganyika. The plankton of Tanganyika is of special interest as being the first received from that lake, and as containing species of a very noteworthy character. The paper contains 36 species and one genus of fresh-water algæ, and two Peridinieæ, all new to science. The author devotes a chapter to the special character of the phytoplankton, and gives a table showing the distribution in the three lakes, and in a second table contrasts the relative frequency of the various species between July 1904 and February 1905. A systematic account of the algæ of the collection is followed by a general summary of the investigation. The algal flora of Tanganyika differs very much from that of Nyasa or Victoria Nyanza, but its peculiarities are all of them such as could be accounted for by the prolonged isolation of the lake. Those algæ of Tanganyika which exhibit marine affinities may have been produced by a gradual increase in the salinity of the water over an extended period of time. The relatively small proportion of Chlorophyceæ in the plankton, and the large proportion of Bacillarieæ and Myxophyceæ, are also indications that the water of the lake was at one time much more saline than it is at present. In large bodies of fresh water, such as these central African lakes, it would appear that a single sample of plankton obtained in a stated locality must not be regarded as representative of the plankton of the entire lake.

Some British Phæophyceæ.†—A. D. Cotton records three species new to Britain, and makes notes on several other interesting members of Phæophyceæ. The new records are *Ascocyclus affinis* Sved., which has never been found since it was first described; *Hecatonema diffusum* Kylin and *Streblonema effusum* Kylin. The first of these was found on

* Journ. Linn. Soc., xxxviii. (1907) pp. 81–197 (9 pls.).
† Journ. of Bot., xlv. (1907) pp. 368–73.

Laminaria saccharina in Cawsand Bay, Cornwall. It is distinguished by the size of the ascocysts and plurilocular sporangia, which measure $30–50 \times 8–12\ \mu$ and $40–50 \times 6\ \mu$ respectively. The author finds that *A. affinis*, though a sharply defined species, is found to vary in certain particulars: (1) the form of the basal disk; (2) the size and form of the sporangia; (3) the presence or absence of erect filaments. *Hecatonema globosum* Batters is recorded from Swanage, the only previous British record being from the Island of Cumbrae. A new variety, *nanum*, is described and interesting notes made on the species and its systematic position. *H. diffusum* was found at Swanage on *Rhodymenia palmata*, *Ectocarpus Padinæ* Sauv. and *Streblonema volubile* Thur. are discussed, and a plant is referred doubtfully to the latter species.

Algæ from the Indian Ocean and China Sea.*—A. D. Cotton publishes notes on ten species of marine algæ in the Kew Herbarium, two of which he describes as new. One is *Scinaia complanata* (= *S. furcellata* Biv. forma *complanata* Collins ms. in Phyc. Bor. Amer., No. 836). It is here recorded from Japan (Enoura, Saido 9). The other novelty is *Euptilota Fergusonii* from Ceylon (Pantura, Ferguson, No. 20), which is fully described and figured.

Alaria esculenta.†—F. Börgesen writes an interesting note on the question whether *Alaria esculenta* sheds its lamina periodically or not. He points out that Harvey, Areschoug, Kjellman, Wille and Reinke state that the frond falls off at certain seasons and is replaced by a new one. On the other hand, Phillips so long ago as 1896 mentioned that an intercalary growth takes place in *Alaria* in the same region as in the *Laminarias*, and that this growth is continuous in *Alaria*, while in *Laminaria* it is periodic. Börgesen has maintained the same view as the result of his observations in the Faeroes, and his conviction is further strengthened by a letter sent to Ostenfeld on the subject by Rasmussen of the Faeroes High School. That gentleman has carefully watched the formation of the new leaves in *Alaria*, and he writes as follows: "They do not shed them like the *Laminaria* species, but the leaf continues its growth in the limit between stalk and leaf; here the midrib is always fresh. On a coast so exposed as this one the greater part of the long lamina is worn away during the winter and the growth is also rather slow in the months of Nov.-Jan." The author is therefore quite convinced of the accuracy of his own and of Phillips' observations for the Faeroese and British coasts respectively, and he surmises that the same method of growth will be found in *Alaria esculenta* wherever it may be found.

Colpomenia sinuosa.‡—L. Mangin writes a note on the serious invasion of the oyster beds on the French shores by this alga, which has now penetrated from Morbihan, where it was first found in the Channel, to Belle-Isle, Quiberon, Cherbourg, Gatteville, and St. Vaast. These algæ are spherical or ovoid, solid when young, later hollow and filled with water. They may attain the size of a hen's egg or even of a fist.

* Kew Bull., No. 7, 1907, pp. 260–4 (1 pl.).
† Bot. Tiddsk., xxviii. (1907) pp. 191–202.
‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 793–5.

These plants become attached when young to the oysters and gradually increase in size. When they have attained a certain size and are left uncovered by the retreat of the tide, they split from the pressure of the water they contain, and this, trickling out, is replaced in part by air. The rising tide imprisons this air, the alga swells, rises, and carries up with it the oyster to which it is attached. The whole thing is then wafted away by currents, and in this way no less than 400,000 oysters have been, according to Fabre-Domergue, removed from the oyster-beds. The same author states that this evil is to some extent mitigated by the drawing of faggots of thorn-bush over the beds, and thus breaking the "balloons." L. Mangin does not consider that this growth of *Colpomenia* is at all likely to diminish or disappear, but that the favourable conditions created by the Gulf Stream are likely, on the other hand, to encourage a further distribution of it along the Channel shores.

Germination and Affinities of Cladostephus.*—C. Sauvageau has succeeded in watching the germination of *Cladostephus verticillatus* and has by this means determined for the first time its affinities. As is well known, the plant consists of a creeping thallus which bears upright, "indefinite," deciduous shoots, but the origin of the creeping thallus and the means by which the indefinite shoots arise have been unknown. The author is now able to give information on both points. The zoospore produces first a small compact mass of cells, from which arise several long filaments. The first formed are simple, and bear here and there a hair; these are identical with *Sphacelaria*. The later filaments are larger and bear several holoblastic branches in the manner of *Halopteris* with one or two hairs in the axil. Sometimes on vigorous plantlets the same filament has first the character of a *Sphacelaria* and then of a *Halopteris*. From the lower surface or from the edge of the small germination-disk, there arise slender rhizoids and long stolons terminated by a "sphacele." The stolons become enlarged here and there by lateral expansions, which produce new upright shoots. Finally, in the middle of the bunch of *Sphacelaria*- and *Halopteris*-like shoots, rich in chromatophores, rises a larger, less coloured stem, which is one of the indefinite shoots of *Cladostephus*. The first of its secondary cells are sterile and very early produce corticating rhizoids; the upper secondary cells bear lateral shoots, but instead of being verticillate as on the adult plant, they are first single or opposite. Only later do the shoots grow verticillately. This likeness of the young plant to the shoots of *Sphacelaria* and *Halopteris* is an important guide to the affinities of *Cladostephus*.

Hæmatococcus.†—W. Wollenweber has examined species of *Hæmatococcus* with a view to deciding whether or no the cells possess an eyespot. On this point there has been some indecision in the past, but this author is able to prove that all the species (3) possess a stigma in all motile stages of development. The presence of a stigma was first proved by him in green forms of *H. pluvialis*, and he gives details of his methods of preparation, etc. Subsequently, he found the stigma in red forms

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 921–2.
† Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 316–21 (1 pl.).

also, and he describes once more his successful manner of procedure. The form of the eyespot in *H. pluvialis* is very different. In older individuals the club-shape predominates, while in the younger ones the form is that of a sharp-angled, spherical triangle. It lies in the periphery of the upper part of the cell, mostly near the equator, and at the same level as the nucleus. The size varies from 2–13 μ long by 1·5 μ broad, while the average zoospore is about 5 μ long. The stigma of *H. Bütschlii*, as described by Blochmann, lies at the level of the front pyrenoid or even higher, is 2 μ long and half-moon shaped. The author further describes the stigma found in a third species of *Hæmatococcus* from Dröbak in the Christiania fjord, and named by him *H. dræbakensis*. It lies below the upper pyrenoid and somewhat in front of the equator. The length is about 2 μ, the width up to 1 μ, and the form resembles that of the stigma of *H. pluvialis*. The position of the stigma is constant in all 3 species during the growth of the swarm-cells; but before vegetative division, it shifts right up to the front end in *H. Bütschlii* and *H. dræbakensis*, while in *H. pluvialis* it retains its position throughout.

Literature of Cyanophyceæ.*—K. Zacharias writes a review of the literature which has appeared since 1904 treating of Cyanophyceæ, the most important of which is Fischer's Zelle der Cyanophyceen.† The latest results and opinions of authors are summarised in detail under the headings: Peripheral protoplasm; the limiting of the central body; occurrence of glycogen, granular contents, cell-division. As regards the granular contents, two kinds appear to be commonly present: (1) Cyanophycin grains in the peripheral protoplasm; (2) central grains in the central body. Statements regarding the presence of grains in other parts of the cell require confirmation.

Peridinieæ of the Pacific.—C. A. Kofoid ‡ describes the structure of *Goniaulax triacantha* Jörg., an arctic form previously imperfectly known and incorrectly figured. He also § describes *Triposolenia*, a new genus of Dinophysidæ, with eight species, five of which are new. He discusses the specific characters and points out the significance of the asymmetry of the genus. He also reports ‖ upon the Peridinieæ collected in the eastern tropical Pacific during the cruise of the United States Fish Commission steamer 'Albatross' in the winter months of 1904–5. He describes and figures 99 new species. He discusses¶ the limitations of isolation in the origin of species, and draws some arguments from the coincident abundance of species of *Ceratium* in the Pacific off San Diego in California. He also gives** descriptions and figures of 22 new forms of plankton collected off San Diego since 1901. These include 19 species and 2 sub-species new to science.

* Bot. Zeit., lxv. (1907) pp. 265–87. † Op. cit., lxiii., 1905.
‡ Zool. Anzeig., xxx. (1906) pp. 102–5 (figs.).
§ Univ. of California Publications (Zoology) iii. (1906) pp. 93–133 (3 pls. and figs.).
‖ Bull. Mus. Comp. Zool. Harvard, l. (1907) pp. 163–207 (17 pls. and map).
¶ Science, xxv. (1907) pp. 500–6.
** Univ. of California Publications (Zoology) iii. (1907) pp. 299–340 (12 pls.).

HOYT, W. D.—**Periodicity in the Production of the Sexual Cells of Dictyota dichotoma.** *Johns Hopkins Univ. Calendar, Notes Biol. Lab.*, March 1907, pp. 25–8 (2 charts).

KNIEP, H.—**Beiträge zur Keimungs-Physiologie und -Biologie von Fucus.** (Contributions concerning the physiology and biology of the germination of *Fucus.*) *Pringsheim's Jahrb. Wiss. Bot.*, xliv. (1907) pp. 635–724.

QUELLE, F.—**Bemerkungen über den inneren Bau einiger Süsswasser-Diatomeen.** (Remarks on the inner structure of certain fresh-water diatoms.)

[Several species have been examined by the author, among them *Nitzschia amphioxys*, *N. sigmoidea*, and *Cylindrotheca Gerstenbergeri*, which are figured.] *Mitth. Thüring. Bot. Verein.*, 1907, pp. 25–31.

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

Notes on Mucorini.*—A. Henneckel has made some observations on the histology of the Mucoraceæ. He claims to have observed true karyokinesis. Also in the chlamydospores of *Mucor racemosus* he has observed nuclear fusion; at first the cell contained 10–12 nuclei, which gradually fused and became one large nucleus.

The same author,† along with Tschernjajew, has experimented on metallotropism in *Phycomyces nitens*. They found that copper was repellent, while iron and aluminium were attractive.

A. Lendner ‡ writes on the different substrata in which Mucorini may be found, and he gives an account of the different localities where he has collected these fungi from the plains to the summit of Mont Blanc. He gives diagnoses of three new species.

Review of Phycomycetes.§—G. W. Wilson takes up the various genera that have been included in the Peronosporales, and gives an account of each, its origin and present position in the order. He indicates those genera which are imperfectly described, or of which the names ought to be dropped in favour of an earlier nomenclature.

Pythium.‖—E. J. Butler has published a monograph of this genus of fungi, with an account of some Chytridiaceæ. All the species of *Pythium* are capable of saprophytic life, though a few are also parasitic. The author considers that the conidia arose from the zoosporangia; he thinks also that the passage from sexual to asexual fructification took place early in the history of the plants, before they had branched off from the Algæ. Butler treats in the second part, the Chytridiaceæ that are parasitic on *Pythium*. He describes several new species.

Clithris quercina.¶—F. W. Neger and W. Dawson have made a careful study of this fungus, which is very common on dead or dying

* Scripta Bot. Hort. Univ. Imp. Petropol. xxiii. (1906) pp. 124–32 (6 figs.).
† Tom. cit., pp. 115–23 (6 fig.). See also Ann. Mycol., v. (1907) p. 310.
‡ Bull. Herb. Boissier, ser. 2, vii. (1907) pp. 249–51. See also Bot. Centralbl., cv. (1907) p. 277.
§ Journ. Mycol., xiii. (1907) pp. 205–9.
‖ Mem. Dept. Agric. India. Botany, ser. 1, No. 5 (1907) 160 pp., 10 pls. See also Ann. Mycol., v. (1907) pp. 288–9.
¶ Ann. Mycol., v. (1907) pp. 214–20 (2 figs.).

branches of oak. They found that the mycelium was restricted to the dead parts of the branch, but at a short distance from the fungus there was a change in the tissue marked by the presence of thylosis. The fungus fructifies and scatters its spores in early spring. Cultures were made on pine, but though pycnidia appeared, no spores and no further fruiting stages were formed. From their cultures and observations the authors proved that *Clithris quercina* is not a true parasite, but only a wound parasite. The mycelium can penetrate from the dead to the living tissue, but only in branches that have been weakened already by caterpillars or some other agency, and would have died soon in any case. It is, however, undoubtedly the case that the fungus hastens the destruction of the branch.

Notes on Yeasts.*—C. Bergen has described a method of separating *Mycoderma* yeast from vinegar bacteria. This is done by the presence of acids and by changes of temperature.

P. Lindner and F. Stockhausen † have tested the power that certain yeasts and fungi have of assimilating the substances produced by yeasts. They found that fungi grew well on these products; a difference was noted in the behaviour of different yeasts towards them.

E. Pantanelli ‡ has directed his attention to pressure and tension of the yeast-cells, and has cultivated them on various substances in varying conditions of light and temperature. He concludes from his experiments that alcoholic yeast is not rightly described as "facultative anaerobic," but rather, he thinks, it can survive a period without air.

Th. Bokorny § criticises the conclusions arrived at concerning the substance called Wildier's *Bios*. He recapitulates its supposed properties: among others, the power to induce fermentation. Bokorny thinks in cases where fermentation did not take place, there was not so much a lack of *Bios* as a too great quantity of some mineral poison. He concludes by asserting that protoplasm and not *Bios* is the sole basis of life.

The influence of spectral colours has been tested on the sporulation of *Saccharomyces* by J. E. Purvis and G. R. Warwick.‖ They found (1) that the red rays hastened sporulation; (2) that the green rays caused delay; (3) blue and violet rays retarded growth even more than the green rays; and (4) the ultraviolet rays had even more effect in checking the life-capacity of the cells.

M. A. Sartory ¶ contributes a study of *Saccharomyces glutinis*, a rose-coloured yeast that grows on cheese, ground cereals, and many other fermentable organic substances. He made cultures on various media, and notes the results. The yeast is composed of rather small oval cells; ascospores were not formed.

* Wochenschr. Brauerei, xxiii. (1906) No. 44. See also Ann. Mycol., v. (1907) p. 312. † Tom. cit., pp. 519–23. See also Ann. Mycol., v. (1907) p. 312.

‡ Atti Rend. Accad. Lincei, ser. 5, xiv. (1905) pp. 720–6. See also Ann. Mycol., v. (1907) pp. 312–13.

§ Allgem. Brauer-Hopfen Zeitung, Feb. 7, 1907. See also Centralbl. Bakt., xix. (1907) pp. 331–3.

‖ Proc. Camb. Phil. Soc., xiv. part 1 (1906). See also Centralbl. Bakt., xix. (1907) pp. 333.

¶ Bull. Soc. Mycol. France, xxiii. (1907) pp. 87–9.

Mycoderma Yeast as Saké Disease.*—T. Takahaski found the variety of yeast, which he describes, in spoiled saké. Its presence was demonstrated by its oxidising energy, alcohol being transformed into carbohydrates and water. The *Mycoderma* is formed of ellipsoid, rarely globose cells. It has been named *Mycoderma saprogenes saké*.

Penicillium crustaceum.†—P. Schürhoff contributes a cytological study of the conidial form of this fungus. He describes his methods of culture and fixation of the fungus and then gives his observations on nuclear division. This is preceded by the formation of two chromosomes which divide to form four daughter-chromosomes; a spindle is also found to lie between the two groups of chromosomes. As soon as the spore nucleus passes into the newly formed spore a new division begins in the sterigma.

Hyphomycetes.‡—G. Lindau completes in this number the section of Phæodidymæ, publishing therewith an index of the genera dealt with and also an index of the illustrations. He begins a new volume with the Phæophragmiæ, and describes the Clasterosporieæ and part of the Septonemeæ. In a short preface he speaks of the difficulty he finds in determining the plants imperfectly described by old writers. Lindau pays particular attention throughout the work to species that are parasitic on the higher plants, causing disease of the tissues.

Influence of Locality on the Development of the Peridium in the Uredineæ.§—Boris Iwanoff has taken the changes occurring in the peridial cells as an indication of the influence of environment on growth. He tested first the effect of temperature, and found that the presence or absence of sunlight had a marked influence on the duration of the incubation period of the spores. It was much shorter in sunlight, and low night temperatures also retarded development of the uredospores. He then examined and measured a large series of the peridial cells of *Æcidia* on many different hosts. He divides the depth of the whole cell by the depth of the outer and inner wall, and compares the quotients one with another. He thus finds that the plants in dry or fresh soil with xerophilous leaf-structure have a quotient under 2 with a few exceptions. The plants on damp soil or on water-plants with hygrophilous structure in the leaves have a quotient over 2, again with a few exceptions. Plants growing in woods have with hygrophilous structure always a quotient over 2. In measuring the cells of the host-plants, he finds that xerophilous species have always a quotient under 2. The parallelism is very marked when species are taken that grow on the same genus of host-plants. The paper is illustrated throughout by drawings in the text of the host-cells and the peridial cells, and the different sizes of cells, walls, and lumen are given with the quotient in each case.

* Bull. Coll. Agric. Imp. Univ. Tokyo, vii. 1 (1907) pp. 101–9. See also Bot. Centralbl., cv. (1907) p. 246.

† Beih. Bot. Centralbl., xxii. (1907) pp. 296–8 (1 pl.).

‡ Rabenhorst's Kryptogamen Flora, i. Abt. 8, Lief. 105 (Leipzig, 1907) pp. 833-52; and Abt. 9, pp. 1–48.

§ Centralbl. Bakt., xviii. (1907) pp. 265–88, 655–72 (44 figs.).

Ustilago esculenta.*—S. Hori found this fungus growing on plants of *Zizania*, and publishes additional observations on it. The smutted shoots retain their greenish colour in autumn, and are thus easily distinguishable from the normal growths. They are eaten as a delicacy by the natives. Hori corrects some erroneous descriptions as to the size and appearance of the smutted shoots and of the spores; he germinated the spores and followed their germination, which does not differ from that of other species of *Ustilago*.

Studies of Hymenomycetes.†—G. R. Lyman has made an extensive cultural study on polymorphism among the Hymenomycetes in order to advance where posssble a knowledge of their life-histories. He discusses first of all the different types of reproduction already known: bud-cell formation, oidia, chlamydospores, and conidia. He describes his own culture methods, and gives a detailed account of some of the forms experimented with. He germinated basidiospores of 75 species of Polyporaceæ, Hydnaceæ and Thelephoraceæ, and found that about 40 per cent. possessed some secondary method of reproduction, usually mycelial oidia or chlamydospores. Oidia were found only among the first of these groups; they germinate readily when fresh, but lose their vitality in one or two days. He comes to the general conclusion that the data bearing on the polymorphism of Hymenomycetes are still too limited to make generalisations of much value; but it appears (*a*) that a considerable majority of Hymenomycetes possess no secondary spores; (*b*) that oidia are common among the Agaricaceæ and Polyporaceæ, and are confined to these two families; (*c*) that chlamydospores occasionally occur in connection with the basidio-fructification, as in *Nyctalis Ptychogaster* and *Fistulina*, and are quite widely distributed on the mycelia of all families; (*d*) that conidia and other highly specialised secondary methods of reproduction are rare and occur more frequently in the Thelephoraceæ than in the higher families. The illustrations show the results of various cultures. There is a long bibliography of the works bearing on the subject.

Conditions of Development in Coprinus.‡—The subject studied by Georg B. Lakon is mainly a question of transpiration, which again is largely connected with the supply of light to the growing plants. He experimented with *C. plicatilis* and made successful cultures on horse-dung and agar-agar mixed with stalks of *Vicia Faba*. Many fungi grow to their full development in the dark, but in the case of this species of *Coprinus*, only mycelium was developed when light was excluded. Lakon traces this to the impossibility of transpiration under the darkened conditions. He describes the results of various experiments in cultures which all helped to confirm this theory. He established another interesting point in the cultures: that the fungus would not produce fruiting bodies on agar-agar made with any kind of solution, unless stalks of *Vicia* were mixed with it. He has not succeeded in explaining this; the mycelium developed richly and normally when transferred to sterilised horse-dung or agar-agar with stalks added.

* Ann. Mycol., v. (1907) pp. 150–4 (2 pls.).
† Proc. Boston Soc. Nat. Hist., xxxiii. (1907) pp. 125–209 (9 pls.).
‡ Ann. Mycol., v. (1907) pp. 155–76.

Belgian Sclerodermæ.*—Ch. Van Bambeke has issued an account of the few Belgian forms of this genus. He sketches their occurrence in literature, and finally describes the four species that occur in Belgium: *Scleroderma aurantium*, *S. Bovista*, *S. verrucosum* and *S. Cepa*. He makes great use of spore characters in diagnosing these species. The spores in the two former are reticulate; in the two latter they are echinulate.

Phalloideæ of Texas.†—W. H. Long has cultivated and studied the members of this group for some years, and gives interesting notes on their growth and development. By gathering the "eggs" and watching them expand, he was able to note variations in species and to determine their relative value. The more constant characters were: colour of stipe, pileus and "eggs," with surface markings of cap and structure of stipe. The shape of both stipe and pileus, presence or absence of a veil, size of stipe and cap, and shape and size of eggs were variable. He describes 5 species: *Phallus impudicus*, *P. rubicundus*, *Mutinus caninus*, *Simblum sphærocephalum*, and *S. texense*. The paper is illustrated by photographic reproductions.

Phenomenon of Sexuality in Recent Work.‡—J. Gallaud traverses the whole subject of sexuality in fungi, relating the various discoveries made and theories held by different workers. He begins with the Phycomycetes, giving a history of the researches on *Polyphagus*, *Pythium*, the Saprolegniaceæ and Peronosporaceæ. All the different stages of advance in our knowledge of the subject are described, with the conclusions arrived at by the scientific experts in this branch of cytology. The work is illustrated by copies of the illustrations published in the papers of the authors under discussion.

Mycology at the École de Pharmacie.§—G. Bainier publishes a series of papers, xii. to xvii., on various mycological subjects. Several species of *Aspergillus* were carefully studied and described, one of them new; they grew on substances in the laboratory. Three new species of *Penicillium* are added to the genus; they are all carefully described and figured. A new genus, *Scopulariopsis*, has been created for those species of *Penicillium* (e.g. *P. brevicaule*) that do not rightly belong to that genus, their branching and general habit being very different. *Scopulariopsis brevicaule* is cultivated for the detection of minute quantities of arsenic. It assimilates an infinitesimal amount, and gives out a strong odour of the poison. *Mucor Mucedo* has the same property, and it is the latter fungus that constitutes the source of danger in a wall-paper coloured with arsenical green. The fungus growing on the paste used to fix the paper assimilates the arsenic, and gives it out again in strong arsenical fumes. Two new species of *Scopulariopsis* are described.

A new genus of Mucedineæ, *Guegenia*, is figured and described; it bears brightly-coloured, 2-septate spores terminal on the branches of the conidiophore.

* Bull. Soc. Roy. Belg., xliii. (1906) pp. 104–14 (4 figs.).
† Journ. Mycol., xiii. (1907) pp. 102–14 (4 pls.).
‡ Rev. Gen. Bot., xix. (1907) pp. 302–4, 350–2, and 392–400 (13 figs.).
§ Bull. Soc. Mycol. France, xxiii. (1907) pp. 90–114 (7 pls.).

Another new genus of Dematieæ, *Cephalomyces*, was discovered; black septate spores are grouped on the upper half of vesicular heads.

Gliocladium roseum and *Cephalosporium acremonium* have been cultivated and carefully described and figured. The specimen of the latter he suggests may be a new species, as it departs considerably from the typical appearance of the mould.

New American Fungi.—Geo. F. Atkinson and C. W. Edgerton* found a fungus growing on the stems and pods of a vetch in company with *Ascochyta*. It grows below the epidermis which it splits, and the spores ooze out in a mass. These are borne 4–8 on the basidia, which form a definite hymenium. The name *Protocoronospora* has been given to the new genus.

J. J. Davis† also describes a parasitic fungus, *Protomyces gravidus* sp. n., which grew on *Bidens*. He compares it with a species found on *Ambrosia*, and finds great similarity between the forms.

Nitrogen Assimilation of Fungi.‡—Charlotte Ternetz has conducted a series of investigations into the question of assimilation of free nitrogen by fungi, and claims to have proved that it takes place to a much greater extent than was previously known. She selected fungi from the roots of Ericaceæ, and has in the course of her work diagnosed five new species of *Phoma*. The power of nitrogen assimilation was proved to vary for different fungi. *Penicillium glaucum* and *Aspergillus niger* absorbed very little, probably only doing so when grown in nitrogen-free cultures. Methods are given, and quantities calculated.

Case of Poisoning.—The case is reported from America, and was traced to the eating of *Amanita phalloides*. Otto E. Jennings,§ who visited the neighbourhood where it occurred and identified the fungus, writes an account of the fatal attack. He describes the symptoms, which were those usually ascribed to the action of phallin poisoning.

Gotthold Hahn ‖ discusses the fungi that proved fatal in a poisoning case at Gera in August, 1905. There also, several harmful fungi were eaten, but the most deadly was *Amanita phalloides*. Several poisonous *Lactarii* had also been used, *L. pyrogalus*, *L. turpis*, and *L. torminosus*. The writer adds a warning against *Scleroderma vulgare*.

Influence of Fungi on Bacterial Cultures.¶—E. Friedländer and H. Doepner found that when phosphorescent bacteria in their cultures had entirely lost the power of emitting light, they could be restored by the introduction of a filamentous fungus (*Mucor stolonifer*, *Aspergillus niger* and *fumigatus*, and *Penicillium glaucum*) into the culture. They did not entirely determine the reason for this; the fungi made the cultures more alkaline, and that had some influence, but not enough to explain the rather remarkable effect.

* Journ. Mycol., xiii. (1907) pp. 185–6. † Tom. cit., pp. 188–9.

‡ Jahrb. Wiss. Bot., xliv. (1907) pp. 353–408 (2 figs.). See also Hedwigia, xlvii. (1907) pp. 18–20 (Beibl.). § Journ. Mycol., xiii. (1907) pp. 187–8.

‖ Jahresb. Ges. Freund. Nat. Gera, Russia, 1906, pp. 104–7. See also Centralbl. Bakt., xix. (1907) p. 327.

¶ Centralbl. Bakt., xliii. (1907) pp. 1–7. See also Bot. Centralbl., cv. (1907) pp. 58–9.

Mycological Notes.*—Blas Lazaro é Ibiza publishes a second series of these notes consisting of descriptions of drawings and photographs issued by him, and of advice as to preserving specimens dry and in liquid. He then gives detailed descriptions of the Mycetozoa, *Arcyria punicea* and *Lycogala miniatum*, of various genera and species of Uredineæ new to Spain, and of a number of Basidiomycetes and of the larger Discomycetes, all of them first records for the country.

M. A. Sartory † gives an economic account of *Elaphomyces granulatus*, which grows in great abundance in the Grand Duchy of Baden and in Alsace-Lorraine. In one forest village, enough of the fungi are collected to nourish 300 pigs during April and September. Neither horses, hares, nor dogs will eat these fungi.

Considerable ambiguity has existed concerning the fungus *Agaricus pudicus*. P. Dumée ‡ clears this up by citing all the literature and figures, and deciding which is the true *A. pudicus*. Bulliard had included two species in his description.

L. Lutz § has experimented with preservative fluids that will retain the colours of fungi. He finds that acetate of mercury with acetic acid in the solution will keep the colours and forms of the fungi almost unchanged.

Fungi of Ants' Nests.‖—H. Jumelle and H. Perrier de la Bathe have been examining the development of mycelium from the nests of the termite ants in Madagascar. They constantly found a species of *Podaxon* growing near or on the ant hills, without however being able to prove continuity between the fungus and the mycelium in the nests. They record further experiments with the contents of a recently abandoned nest in which the mycelium grew with great vigour, and then formed the stromata of a species of *Xylaria*. They do not claim more from their observations than to have proved the impossibility of stating definitely that any one particular fungus is utilised by the ants.

Fungus-eating Ants of Madagascar.¶—H. Jumelle and H. Perrier de la Bathe have made a series of observations on this subject. The ants that inhabit the open plain cultivate fungi for food as well as those that live in the woods; but while the latter cultivate the fungus all the year round, the former prepare the culture "balls" during the wet season only in preparation for the dry season, which lasts from May to November. The culture "balls" are composed of innumerable molecules of vegetable matter worked up by the ants, a small quantity of earth being used as cement. The writers examined the fungus and concluded that it was a form of *Œdocephalum*, one of the Mucedineæ. They obtained no indication as to the higher fruiting form.

Form-development in Agarics.**—Werner Magnus has conducted a series of experiments on developing Agarics to test their power of

* Mem. Real. Soc. Españ. Hist. Nat., v. (1907) pp. 1–47 (3 pls.).
† Bull. Soc. Mycol. France, xxiii. (1907) p. 86. ‡ Tom. cit., pp. 115–16.
§ Tom. cit., pp. 117–20. ‖ Comptes Rendus, cxlv. (1907) pp. 274–6.
¶ Comptes Rendus, cxliv. (1907) pp. 1449–51.
** Arch. Biontol., i. (1906) pp. 85–161 (6 pls.). See also Bot. Zeit., lxv. (1907) pp. 253–5.

regeneration. In the very young stages, changes as a result of wounding could not be observed; a little later when the hymenium was forming, an injury healed easily. When the hymenium was comparatively old, regeneration was much slower, and finally failed altogether.

Dry-rot.*—A. Möller has edited a pamphlet containing contributions by himself and others on the fungi that cause dry-rot. Richard Falck, who takes the first paper, reviews the work already done on this subject. C. Flugge discusses the supposed connection between dry-rot and carcinoma in men and animals, giving results of various experiments, and deciding that no direct connection has been proved, but indicating that houses which harbour dry-rot owing to dampness and lack of suitable ventilation are essentially unhealthy. Möller himself gives a special account of *Merulius lacrymans*, and Falck follows with a second paper on the physiological conditions of growth of this and other fungi that also destroy wood. The illustrations are from drawings and from photographic reproductions in the field and from microscopic preparations. Three of the photographs are prepared as stereoscopic views.

Plant Diseases.—John L. Sheldon† has examined the fungus that causes leaf-tip blight of *Dracena*, which had been provisionally placed by Halsted in the genus *Glœosporium*. Sheldon gives a careful description of the parasite, and concludes that it belongs to the genus *Physalospora*.

A number of plant diseases are notified by the experts to the Board of Agriculture.‡ Straw blight in wheat, due to *Ophiobolus graminis*, causing the stalks to rot, was reported from Cambridgeshire; diseased oats were infected by *Helminthosporium teres*; white rust attacked salsify plants; mildews on apples, *Euonymus* and rose were treated. A more lengthy description of apple-tree mildew, *Sphærotheca Mali*, is given; it is very prevalent and more harmful to full-grown trees than to nursery stock. Advice is given as to treatment.

E. S. Salmon§ publishes an account of cherry-leaf scorch, due to the fungus *Gnomonia erythrostoma*. He describes the fungus, its life-history, and method of attacking the leaves, and gives his experience of dealing with the evil. The method of plucking the diseased leaves has been entirely successful where it has been thoroughly carried out, but as it is a difficult and expensive operation, Salmon has been experimenting with spraying Bordeaux mixture. He has found that very efficacious, the disease yielding readily to such treatment. Certain varieties of cherry-trees have been found to be immune to the disease, and though the wild cherry becomes infected, it seems to be able to recover in the course of a few seasons.

J. Miyake‖ found trees of *Morus alba* damaged by *Phyllactinia suffulta*, and by a species of *Uncinula*. He describes other fungoid pests on apple, and also on tea plants.

* Jena: Gustav Fischer (1907) iv. and 154 pp. (5 pls.).
† Journ. Mycol., xiii. (1907) pp. 138–40.
‡ Journ. Board Agric., xiv. (1907) pp. 358–60 (1 fig.).
§ Tom. cit., pp. 334–41 (3 figs.).
‖ Bot. Mag. Tokyo, xxi. (1907) pp. 1–6 and 36–44 (1 fig.). See also Ann Mycol., v. (1907) pp. 295–6.

A disease of haricot beans was found by A. Puttemans* to be due to *Isariopsis griseola*; it attacks both leaves and pods, and works great harm to the host-plants. The fungus *I. griseola* is synonymous with *Cercospora columnaris* and *Arthrobotryum Puttemansii*. Methods of combating the disease are given.

Garden roses had their stems attacked by spots on which spore-containing pustules were developed. R. Laubert† diagnosed the fungus (one of the Sphæropsideæ) to be a new species of *Cryptosporium*, *C. minimum*. The branches had been weakened by the frost of the previous winter, and thus rendered less resistant to fungoid attacks. The branches were killed by the fungus.

H. Diedicke‡ has examined the nature of the leaf-spots of ivy. He found growing on them three fungi, *Phyllosticta hedericola*, *Ph. hederacea*, and *Vermicularia trichella*. There were some other fungi present, but of less importance. A series of infection experiments was carried out, and it was proved that *Ph. hedericola* and *V. trichella* were not able to infect old and undamaged ivy leaves, but their spores could penetrate through wounds, and give rise to the leaf-spots. A further set of experiments on young leaves confirmed this view. *Ph. hederacea* is not a parasite: it lives parasitically on the tissue killed by the other two forms.

Cones of the birch were noticed by F. W. Neger§ to be constantly brown at the tips. When they were kept in a damp chamber, these brown portions produced a *Botrytis* form. Many cultivations were made, and the results obtained showed that two kinds of sclerotia were found in the cones: *Sclerotinia Betulæ*, which grows on the fruit, and of which the conidial stage is *Monilia*, and the sclerotium of a *Botrytis*, presumably *B. cinerea*, which grows on the scales; no apothecia were formed.

T. Petch‖ finds that root disease of *Hevea brasiliensis* is due to a fungus, *Fomes semitostus*. He found the mycelium on the affected roots.

Further instalments of the Handbook of Plant Diseases have been issued by Sorauer and Lindau.¶ Part 8 treats of diseases due to Ascomycetous fungi, more especially *Monilia* and *Sclerotinia*. The Ustilagineæ and Uredineæ are also dealt with.

E. L. Bouvier** has described again the ravages caused to the fir *Abies pectinata*, in the Jura mountains, by some parasitic disease, probably the fungus *Rhizosphæra Abietis*; but no exact diagnosis of the cause of the malady was possible. The writer recommends the removal of the trees attacked.

E. S. Salmon†† has found an *Oidium* on *Prunus Laurocerasus* identical

* Rev. Agric. S. Paulo, 1906, pp. 200–4 (3 figs.). See also Ann. Mycol., v. (1907) p. 297.

† Centralbl. Bakt., xix. (1907) pp. 163-8. ‡ Tom. cit., pp. 168–75 (1 pl.).

§ Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 368–72 (1 fig.).

‖ Circulars and Agric. Journ. Roy. Bot. Gard. Ceylon, iii. No. 17 (1906) pp. 237–42. See also Bot. Centralbl. cv. (1907) p. 171.

¶ Handbuch der Pflanzenkrankheiten. Berlin: Paul Parey, lief. 6–10 (1906). See also Bot. Centralbl., cv. (1907) pp. 196–8.

** Comptes Rendus, cxlv. (1907) pp. 537–41.

†† Journ. Roy. Hort. Soc., xxxi. (1906) pp. 142–6.

with *Sphærotheca pannosa*. The growth of the fungus is not vigorous, and it is suggested that the fungus is not fully adapted to its host.

The fungous diseases of Indiana for the year 1906 on fruits, vegetables, and cereals are reported on by F. D. Kern.* Notes are given on the control of plant diseases.

Three leaflets issued by the Board of Agriculture† deal respectively with *Rhytisma acerinum* on sycamore, which can be stamped out by destroying the fallen leaves; with *Nectria Solani*, the winter rot of potatoes; and with *Pseudomonas campestris*, a bacillar disease which attacks cruciferous plants, and does great damage to cabbages and turnips. Advice is given as to the treatment of these diseases.

W. Busse‡ publishes the report of the pathological expedition to Cameroon and Togo. Insects as well as fungi are included among the plant parasites; among the latter were *Phytophthora* on cocoa-trees, and *Uredo Gossypii* on cotton.

A disease of maples in Vienna has been determined by F. von Höhnel§ to be caused by a resupinate Polypore, *Poria obliqua*. It develops under the thick bark, and after throwing this off, spreads widely on the naked wood. The writer suggests that possibly the mycelium lives in the cambium without killing it; it is perennial although the fruiting body is annual, and falls to the ground when it reaches the surface and dries up.

The gooseberry and currant disease caused by *Glæosporium Ribis*, has been experimented on by Ewerts, of Proskaw.‖ He made a large series of culture and infection experiments, as well as tests for the best methods of treating the disease. He does not find that the mycelium winters in the host-plant; he rather concludes that the conidia retain their power of infection till the following season. Bushes are not attacked until they have grown for some time. The most susceptible time for infection is the month of May, and at that date the bushes should be sprayed with Bordeaux mixture. The treatment has had very good results.

A. Rant¶ gives a description of the effects of gummosis in the Amygdalaceæ. He describes the effect on the tissues. The organisms that are found in the wounds, and that either cause or increase the trouble, are bacteria, fungi, and insects. *Clasterosporium carpophilum* and *Coryneum Beijerinckii* are the fungi that cause most of the trouble. A number of others, however, have been found to give rise to gummosis in Amygdalaceæ, and cause the death of the host.

A new work on plant pathology has been begun by Arno Naumann.**

* Bull. Exper. Stat., Purdue Univ., 119 (1907) pp. 427–32. See also Bot. Centralbl., cv. (1907) pp. 243–4.

† Board of Agric. and Fisheries, 4 Whitehall Place, London, S.W., Leaflets Nos. 183, 193, and 200.

‡ Beih. Tropenpfl. Jahrg., 1906, Nos. 4 and 5, 100 pp., 4 pls. and 8 figs. See also Centralbl. Bakt., xix. (1907) pp. 350–2.

§ Oesterr. bot. Zeitschr. Wien, lxii. (1907) pp. 177–81. See also Bot. Centralbl., cv. (1907) pp. 361–2.

‖ Zeitschr. Pflanzenkr., xvii. (1907) pp. 158–69 (2 pls.).

¶ Diss. Amsterdam, 1906. See also Zeitschr. Pflanzenkr., xvii. (1907) pp. 179–80.

** Die Pilzkrankheiten gärtnerischen Kulturgewachse. Dresden: C. Henrich, viii. and 156 pp., 3 pls. and 42 figs.

His object is to supply gardeners with a handy text-book of the fungi that attack garden plants. He gives in the first chapters an account of the growth and development of the various parasitic fungi; instructions how to examine them microscopically; how to make cultures of them in damp chambers; and finally, how to combat the diseases due to the fungi. In the remaining part he takes up the different classes of garden products, vegetables, shrubs, annuals, and hot-house plants, and for each plant he records the fungi that have been known to infest it, with a short account of them. There are also provided an index of the host-plants and an index of the fungi dealt with in the text.

The Board of Agriculture has issued a leaflet * on the American gooseberry mildew, describing with pen and pencil the serious nature of the disease, and advising growers as to the best methods of treatment.

An account is also published † by the Board of Agriculture of a disease of pines due to the fungus *Diplodia pinea*. This is confined to the terminal shoots, and is recognised by the yellowing and subsequent shedding of the leaves. The fungus is a wound parasite, and the injury spreads about 2 in. in the tissues from the place of infection.

F. L. Stevens and J. G. Hall ‡ describe a black rot of apples characterised by rotten black spots on the fruits. It is due to a hyphomycetous fungus *Volutella fructi* sp. n. The mycelium is black in the presence of carbohydrates; the conidia are colourless. The fungus only gains entrance by some cut or bruise.

A. Osterwalder§ described some time ago the fungi that were commonly found attacking stored fruit. A careful elimination of all the fruits that were infected by *Monilia* and *Penicillium*, has seemingly left a clear field for other forms, and a new species, *Glœosporium album*, was found living on stored apples. The author points out wherein it differs from *G. fructigenum*. He also describes another species of the same genus that grew on the berries of a *Solanum*, and which he names *G. Solani*. The berries only were attacked.

Wilhelm Herter ‖ contributes further information about the gooseberry mildew. He chronicles a number of new localities for the disease, several of them in England, in Worcestershire and Gloucestershire. The fungus has also been found in Kent on *Ribes aureum*. A list is given of new papers on this subject.

G. D'Ippolito¶ records a series of observations on the destruction of maize plants by the fungus *Sclerospora macrospora*. The leaves were destroyed, and flowering completely hindered both on male and female heads. The mycelium and oospores of the fungus were found in the damaged stalks.

Franz Boden** has published an account of the stem disease of pines,

* Board of Agric. and Fisheries, Leaflet No. 195 (1907) 5 pp., 1 pl., 2 figs.
† Journ. Board Agric., xiv. (1907) pp. 164–6.
‡ Journ. Mycol., xiii. (1907) pp. 94–9 (1 pl.).
§ Centralbl. Bakt., xviii. (1907) pp. 825–7 (5 figs.).
‖ Tom. cit., pp. 828–30 (map).
¶ Staz. Sper. Agrar., xxxviii. p. 998. See also Centralbl. Bakt., xviii. (1907) p. 700.
** Die Stockfäule der Fichte, ihre Entstehung und Verhütung. Hameln: Heinrich Keese, 1906, 86 pp., 18 autotypes and figs.). See also Centralbl. Bakt., xviii. (1907) p. 703.

generally held to be caused by *Nectria ditissima*. He considers that the fungus is an after-product, and not the original cause of the trouble. He has proved this by a long series of infection experiments. He recommends methods of dealing with the disease.

A new enemy of the coffee plant has appeared in New Caledonia, and is described by J. Gallaud.* It is a hyphomycetous fungus, *Pellicularia koleroga* Cooke, which attacks the leaves and covers the epidermis of the lower surface, though it scarcely penetrates into the tissues. It gradually smothers the host-plant, interfering as it does with all respiration.

Oidium Euonymi-japonicæ was transported to South Europe with the host-plant, and became there a veritable epidemic. It has also been brought to South England in the same way, and E. S. Salmon† has examined and described its appearance and growth. Perithecia were never developed. The fungus persists through the winter by means of the perennial mycelium in the evergreen leaves of the host.

The dry summer of 1904 was not favourable to the development of the potato disease *Phytophthora infestans*, and some other diseases flourished in an unusual manner. O. Appel‡ made a special study of these diseases on potato and tomato plants. *Stysanus Stemonitis* caused disease spots on the tubers, and prepared the way for other more deadly fungi. *Phellomyces sclerotiophorus* was frequent on the scales, but did not play much part as a disease. On tomatoes *Fusarium erubescens* gave rise to an epidemic. *Phytophthora infestans* was also found on tomato plants. *Fusarium* sp. gives rise to rolling of the leaves; mycelium of the fungus was found in the vessels of the stalk. Lenticels were responsible for allowing the entrance of harmful organisms into the tissues through their openings. Blackening of the stem was not frequent.

E. T. Butler§ describes three fungous diseases of palms which have appeared in India: *Phytophthora*, which attacked the betel palm; a root disease supposed to be due to *Fomes lucidus*; and a disease of palmyra palm and coco-nut palm caused by a *Pythium*, which first infects the young leaves, and extends to the buds, which it destroys.

C. von Tubeuf‖ describes a witches' broom on *Gleditschia*, but he could not find any trace of the organism that had given rise to it. He also describes some diseases on exotic plants in Germany: a Japanese larch was attacked by *Dasyscypha* and by *Cæoma Laricis*, although the leaves are well protected by a waxy coating.

A number of diseased plants were referred to the Board of Agriculture.¶ These were *Rhizoctonia* on rhubarb, silver leaf on plums, shot-hole fungus (*Cercospora circumscissa*) on peach leaves, plane-leaf

* Comptes Rendus, cxli. (1907) pp. 898–900. See also Centralbl. Bakt., xviii. (1907) p. 704.

† Journ. Hort. Soc., xxix. (1906) p. 9.

‡ Jahresb. Ver. Vert. Ang. Bot., iii. (1906). See also Bot. Centralbl.. cv. (1907) pp. 23–4.

§ Agric. Journ. India, i. (1906) pp. 299–310. See also Bot. Centralbl., cv. (1907) p. 58.

‖ Naturw. Zeitschr. Land. Forst., v. (1907) pp. 84–6. See also Bot. Centralbl., cv. (1907) p. 28.

¶ Journ. Board of Agric., xiv. (1907) pp. 221–2.

scorch (*Glœosporium nervisequum*) on plane leaves, and "brown rot" fungus (*Sclerotinia fructigena*) on apple shoots. Directions are given as to spraying, etc.

Fungi of Spoiled Maize.*—Ugo Brizi has examined the moulds that are found on spoiled corn, and has worked on the alterations that are induced in the grain by the growth of the fungi. The consumption of the diseased corn gives rise to the terrible disease Pellagra. The fungus most frequently found associated with the maize is *Penicillium glaucum*. It attacks the seed by the hilum and penetrates through a small mass of spongy tissue at the extremity of the raphe. The mycelium does not pierce the cells: the growth is always intracellular; the protoplasm of the cells becomes disorganised on account of some toxin secreted by the mycelium which traverses the cell-membrane. Other fungi found on the maize, though in much less quantity, were *Sterigmatocystis nigra*, *Mucor stolonifer*, and *M. racemosus*. These fungi could be demonstrated by microscopical examination, but it was only after considerable time that there was any visible alteration of the maize. The author discusses various aspects of the disease, and methods of treating it or stamping it out.

Endotropic Mycorhiza of the Vine.†—While examining the roots of the vine to find out any alterations that might be due to the presence of *Phylloxera*, L. Petri was struck by the unusual development of mycorhiza in all the plants attacked by the insect. No external characters betrayed the presence of the fungus in the root. The mycelium remains always a little behind the apical region. Petri describes the action of the fungus on the plant, and the appearance of the hyphæ.

American Gooseberry Mildew.‡—Under the Destructive Insects and Pests Acts, the Board of Agriculture have issued an order requiring the occupier of any premises on which there is a bush diseased or suspected of being diseased, to notify the presence of the disease to the authorities, when measures will be taken to stamp it out. Two cases of mildew have been reported from Warwickshire.

ABDERHALDEN & TERUWCHI.—**Kulturversuche mit Aspergillus niger auf einigen Aminosäuren und Peptiden.** (Culture research with *Aspergillus niger* on some aminoacids and peptids.)
Zeitschr. physiol. Chem., xlvii. (1906) pp. 394–6.
See also *Bot. Centralbl.*, cv. (1907) p. 57.

ADAMS, J. A.—**Irish Parasitic Fungi.**
[A list of species new to Ireland; two of them, *Claviceps Junci* Adams and *Cicinnobolus Ulicis* Adams, are new to science.]
Irish Naturalist, xvi. (1907) pp. 167–9 (4 figs.).

D'ALMEIDA, J. VERISSEMO, & DE SOUZA DA CAMARA, M.—**Contributions ad mycofloram Lusitaniæ.** (Contributions to Portuguese fungus flora.)
Rev. Agron., iv. (1906) pp. 59–61, 83–5, 137–8, 221–2, 584–5 (3 pls.).
See also *Ann. Mycol.*, v. (1907) p. 184.

* Atti Accad. Reale Lincei, ccciv. (1907) pp. 890–98.
† Tom. cit., pp. 789–91.
‡ Journ. Board Agric., xiv. (1907) pp. 300–1 and 371.

VAN BAMBEKE, CH.—**Quelques remarques sur Polyporus Rostkovii.** (Some remarks on *Polyporus Rostkovii*.)
Bull. Soc. Roy. Belgique, xliii. (1907) pp. 256–65 (2 pls.).

BERLESE, A.—**Sopra una nova specie di Mucedinea parassita del Ceroplastes.** (On a new species of Mucedineæ parasitic on *Ceroplastes*.)
[Lemon-shaped cells were isolated from the host, and when cultivated formed an *Oospora* fructification.]
Redia, Florence, 1905, pp. 8–15 (1 pl. and 3 figs.).
See also *Ann. Mycol.*, v. (1907) p. 287.

BERNARD, CH.—**Une intéressante Phalloidée de Java.** (An interesting Phalloid from Java, *Clathrella Treubii* sp. n.
Ann. Jard. Bot. Buitenzorg, 2 sér., v. (1906) pp. 299–310 (3 pls.).
See also *Ann. Mycol.*, v. (1907) p. 185.

BRESADOLA, J.—**Fungi Javanici.**
[These 36 fungi were collected by E. Heinricher in the years 1903–4; a number of them are new species.] *Ann. Mycol.*, v. (1907) pp. 237–42.

BUBAK, FR.—**Zweiter Beitrag zur Pilzflora von Montenegro.** (Second contribution to the fungus flora of Montenegro.)
[The author gives a list of 256 species, of which 66 are new; 4 are new varieties. There are two new genera, *Schönbornia* (Excipulaceæ) and *Trichofusarium* (Tuberculariaceæ).
Bull. Herb. Bois., sér. 2, vi., (1906) pp. 393–408, 473–88 (2 pls.). See also *Ann. Mycol.*, v. (1907) pp. 185–7.

„ „ **Die Pilze Böhmens.** (The fungi of Bohemia.)
[First part: Uredinales. The account of the fungi is preceded by a sketch of mycology in Bohemia.]
Arch. Naturw. Durchf. Böhmens, xiii. No. 5 (Prag, 1906) 226 pp. See also *Bot. Centralbl.*, civ. (1907) pp. 649–51.

BUBAK, FR., & J. E. KABAT—**Fünfter Beitrag zur Pilzflora von Tirol.** (Fifth contribution to the fungus flora of the Tyrol.)
[A list of species; several of them new.]
Ber. Naturw. Medizin Ver. Innsbruck, xxx. (1906) 20 pp., 1 fig.
See also *Ann. Mycol.*, v. (1907) p. 187.

CHEEL, E.—**List of Fungi from New South Wales.**
[A list of plants collected and exhibited by E. Cheel in Sydney, including several interesting forms.] *Proc. Linn. Soc. N.S. Wales*, xxxii. (1907) pp. 202–4.

CHITTENDEN, F. J.—**The Uredineæ and Ustilagineæ of Essex. Part II.**
[The species recorded number 113.]
Essex Naturalist, xv. (1907) pp. 1–5.

DURAND, ELIAS J.—**The Mycological Writings of Theodor Holmskjold, and their relation to Persoon's Commentatio.**
[A history of the publication of these works.]
Journ. Mycol., xiii. (1907) pp. 141–2.

EYRE, W. L. W.—**A List of the Fungi of the Grange Park and neighbourhood, Hampshire.**
[The larger fungi alone are dealt with, both Basidiomycetes and Ascomycetes.] Winchester: Warren and Sons (1907) 18 pp.

FISCHER, ED.—**Ueber einige von Herrn Prof. E. Kissling in Sumatra gesammelte Pilze.** (On some fungi collected in Sumatra by Prof. E. Kissling.)
[Diagnoses and descriptive notes of several species of Gasteromycetes, and of one Myxomycete, *Alwisia Bombarda*.]
Mitt. Naturf. Gesell. Bern, 1906 (1907) pp. 108–23 (1 pl.).

Fischer, Ed.—**Ueber einige Kalifornische Hypogeen.** (Some Californian Hypogææ.)
[A description of several species; there is one new genus, *Pseudobalsamia*.]
Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 372–6 (1 fig.).

Griffiths, D.—**Concerning some West American Fungi.**
[Several new species are included in the list.]
Bull. Torrey Bot. Club, xxxiv. (1907) pp. 207–11.
See also *Ann. Mycol.*, v. (1907) p. 289.

Hansen, Emil Chr.—**Oberhefe und Unterhefe.** (Studies on yeasts.)
Centralbl. Bakt., xviii. (1907) pp. 577–86.

Harz, C. O.—**Achlya Hoferi Harz, eine neue Saprolegniaceæ auf lebenden Fischen.** (*Achlya Hoferi*, a new Saprolegniaceæ on living fishes.)
Allgem. Fisch.-Zeit., 1906, pp. 365–8.
See also *Ann. Mycol.*, v. (1907) p. 290.

Hausmann, W.—**Zur Kenntnis der von Schimmelpilzen gebildeten gasförmigen Arsenverbindungen.** (On the knowledge of gaseous arsenical compounds formed by filamentous fungi.)
[The author kept white mice in the atmosphere formed by *Penicillium brevicaule* grown on arsenates, without injury to the animals.]
Zeitschr. Hygiene u. Infektionskr., liii. (1906) pp. 509–12.
See also *Bot. Centralbl.*, cv. (1907) p. 60.

Hiekel, R.—**Beiträge zur Morphologie und Physiologie des Soor erregers.** (Contribution to the morphology and physiology of Soor maker, *Oidium albicans* = *Dematium albicans*.) *SB. k.k. Akad. Wiss. Wien, Math-Nat. Kl.*, cxv. (1906) pp. 159–97 (2 pls.).
See also *Ann. Mycol.*, v. (1907) pp. 200–2.

Hohnel, Fr. v.—**Pilze in "Ergebnisse einer naturwissenschaftlichen Reise zum Erdschias-Dagh."** (Fungi of a natural history expedition to Erdschias-Dagh (Asia Minor).
[A number of the species collected are new.]
Ann. k.k. Nat. Hofmus. Wien, xx., 1905 (1907) 6 pp.
See also *Ann. Mycol.*, v. (1907) pp. 187–8.

" " **Fragmente zur Mykologie.** (Mycological fragments.)
[Criticisms of various species of fungi, and descriptions of some new species.]
SB. k.k. Akad. Wiss. Wien Math.-Nat. Kl., cxv. 1te Abt. (1906) pp. 649–95 (2 figs.). See also *Ann. Mycol.*, v. (1907) pp. 187–90.

" " **Revision von 292 von J. Feltgen auf gestellten Ascomycetenformen auf grund der Original-Exemplare.**
[Revision of Feltgen's Flora of Luxemburg. Most of the new species (251) are synonyms of those already existing; others are new but wrongly determined.]
Tom. cit., pp. 1189–1327.

Hohnel, Fr. v. & Litschauer, v.—**Beiträge zur Kenntnis der Corticieen.** (Contributions to the knowledge of the Corticieæ.)
[A re-arrangement of genera and species; two new genera are established, *Glœotulasnella* and *Tomentellina*.] *Tom. cit.*, pp. 1549–1620 (10 figs.).

Jaap, A.—**Zweites Verzeichnis zu meinem Exsiccatenwerk "Fungi selecti exsiccati."** (Second catalogue of Fungi Selecti Exsiccati.)
[Several new species are included, and fuller descriptions of many species already known.] *Abh. Bot. Ver. Prov. Brandenb.*, ii. (1907) pp. 7–29.
See also *Ann. Mycol.* v. (1907) pp. 290–1.

JAAP, O.—**Ein kleiner Beitrag zur Pilzflora des Schwarzwaldes.** (A small contribution to the fungus flora of the Black Forest.)
Allg. bot. Zeitschr., Nos. 7–8 (1906) pp. 122–5.
See also *Bot. Centralbl.*, civ. (1907) p. 607.

" " **Beiträge zur Pilzflora der Schweiz.** (Contributions to the fungus-flora of Switzerland.)
[The list includes 16 new species or varieties.]
Ann. Mycol., v. (1907) pp. 246–72.

" " **Fungi selecti exsiccati. Serien IX. und X. (No. 201–50).**
[A number of interesting forms are included from a wide series of genera.] Hamburg, April 1907. See also *Bot. Centralbl.*, cv. (1907) pp. 222–3.

JOURDE, ANT.—**Action d'une Mucédinée, Pæcilomyces Varioti, sur les hydrates de carbon.** (Action of a mould, *Pæcilomyces Varioti*, on hydrocarbons).
[Culture experiments with glucose, lactose, saccharose, etc.; an enzyme was secreted, not yet identified.]
C.R. Soc. Biol. Paris, lxiii. (1907) pp. 264–6 (2 figs.).

JUNITZKY, N.—**Ueber Zymase aus Aspergillus niger.** (On zymase in *Aspergillus niger*.)
[Zymase was found to be always present in the fungus when grown in good light.] *Ber. Deutsch. Bot. Gesell.*, xxv. (1907) pp. 210–12.

KABAT, J. E., & BUBAK, FR.—**Mykologische Beiträge.** (Contributions to Mycology.)
[Descriptions of 21 new species of microfungi. There are two genera, *Sirexcipula* Bubak (*Excipulacearum*) and *Kabatiella* Bubak (*Mucedinearum hyalosporum*.)] *Hedwigia*, xlvi. (1907) pp. 288–98.

KEISSLER, KARL VON—**Beitrag zur Kenntnis der Pilzflora Kärntens.**
[A long list of fungi, some of them with descriptive notes added.]
Ann. Mycol., v. (1907) pp. 220–36.

KOSTYTSCHEW, S.—**Zur Frage der Wasserstoffbildung bei der Atmung der Pilze.** (On the question of the formation of hydrogen in the respiration of fungi.)
[Results of experiments with various fungi. Hydrogen was given off in anaerobic cultivations of *Agaricus campestris*, but only after bacteria became active.]
Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 178–88.

" " **Ueber anaerobe Atmung ohne Alkoholbildung.** (Anaerobic respiration without alcohol formation.)
[Experiments with *Agaricus campestris* proved that no alcohol was formed.)
Tom. cit., pp. 188–91.

LEMMERMAN, E.—**Die Pilze der Juncaceen.** (Fungi of the Juncaceæ.)
[The author deals with 219 species.]
Abh. Nat. Ver. Bremen, xviii. (1906) pp. 465–89.
See also *Ann. Mycol.*, v. (1907) p. 291.

LIND, J.—**Bemerkenswerte Pilzfunde in Dänemark.** (Notable fungi in Denmark.)
[13 new or rare species are described.] *Ann. Mycol.*, v. (1907) pp. 272–7.

LINGELSHEIM, A.—**Mykologische Beobachtungen.** (Mycological observations.)
[List of fungi in the neighbourhood of Breslau; some of them are new to science.] *Jahresb. Schles. Ges. Vat. Kultur*, 1906, pp. 89–92.
See also *Ann. Mycol.*, v. (1907) p. 291.

MAGNUS, PAUL—**Vierter Beitrag zur Pilzflora von Franken.** (Fourth contribution to the fungus-flora of Franconia.)
[A number of new species are included. *Synchytrium aureum* is recorded on 23 different hosts.]
Abh. Naturhist. Ges. Nürnberg, xvi. (1907) 105 pp.
See also *Hedwigia*, xlvii. (1907) p. 17 (Beibl.).

MASSEE, G.—**Additions to the Wild Fauna and Flora of the Royal Botanic Gardens, Kew. IV.**
[New and additional species of fungi; second series.]
Kew Bull., No. 6 (1907) pp. 238–44 (1 pl.).

MORGAN, A. P.—**North American Species of Agaricaceæ.**
[Lists, with diagnoses of Melanosporæ.]
Journ. Mycol., xiii. (1907) pp. 143–53.

PATOUILLARD, N.—**Champignons nouveaux de Tonkin.** (New fungi from Tonkin.)
[A large number of genera, but few species are represented. There is one new genus, *Dendrosphæra*, near to *Onygena*.]
Bull. Soc. Mycol. France, xxiii. (1907) pp. 69–79 (1 pl.).

„ „ **Quelques Champignons de l'Afrique occidentale.** (Some fungi from Western Africa.)
[A number of new species are described.]
Tom. cit., pp. 80–5.

PECK, CHARLES HORTON—**New Species of Fungi.**
[A number of species, mostly of the larger fungi, are described, from various parts of the American continent.]
Bull. Torrey Bot. Club, xxxiv. (1907) pp. 345–9.

PRINGSHEIM, HANS—**Ueber die Stickstoffernährung der Hefe.** (The nitrogenous food of yeasts.)
[An examination of the source of nitrogen supply for the fungus.]
Bioch. Zeitschr., iii. (1907) pp. 121–286.
See also *Centralbl. Bakt.*, xix., pp. 310–18.

RACIBORSKI, M.—**Einige Chemomorphosen des Aspergillus niger.** (Chemomorphism of *Aspergillus niger*.)
[Tests of that and other filamentous fungi with sulphates, chloroform, and iodine compounds.]
Bull. Intern. Acad. Sci. Cracovie (1905) pp. 714–78.
See also *Ann. Mycol.*, v. (1907) pp. 310–11.

RAJAT, H., & PEJU, G.—**Note sur l'Action pathogène des Levures.** (On the pathogenic action of yeasts.)
[An account of infection experiments with various yeasts.]
C.R. Soc. Biol. Paris, lxiii. (1907) pp. 893–5.

REHM—**Ascomyceten exs. Fasc. 38. Nos. 1676–1700.**
[A large percentage of new and interesting species are included in the lists.] Munchen, 1907. See also *Bot. Centralbl.*, cv. (1907) pp. 245–6.

„ **Ascomyceten exs. Fasc. 39.**
[Specimens 1701-25 are listed; several among them are new to science, and diagnoses are given.]
Ann. Mycol., v. (1907) pp. 207–13.

ROSTRUP, E.—**Polyporus. Schlüssel zur Bestimmung der häufigeren mitteleuropaischen Arten.** (Polyporus. Key to the determination of the commoner Central European forms.) *Ann. Mycol.*, v. (1907) pp. 242–4.

ROUGE, ERNEST—**Le Lactarius sanguifluus et la lipase.**
[Three oxydising substances have been found in this *Lactarius*—amylase, emulsin, and lipase. The paper is a study of the latter.]
Centralbl. Bakt., xviii. (1907) pp. 587–607.

RULLMANN, W.—**Ueber Saürebildung durch Oidium lactis.** (On acid formation by *Oidium lactis*.)

[Experiments proved the importance of *Oidium lactis* in butter- and cheese-making.] *Centralbl. Bakt.*, xviii. (1907) pp. 743–8.

SACCARDO, P. A.—**Notæ Mycologicæ.**

[Descriptions of 7 new species or new varieties of micro-fungi from different localities.]

Ann. Mycol., v. (1907) pp. 177–9.

„ „ **Notæ Mycologicæ. Ser. 8, 1 pl.**

[New species described and figured.]

See *Bot. Centralbl.*, cv. (1907) p. 87.

SCHORSTEIN, J.—**Pilz hyphenbilder.** (Drawings of fungus hyphæ.)

[The author attempts to so represent the hyphæ that the fungus to which they belong can be determined.]

Zeitschr. landw. Ver. Oesterr., 1907, pp. 32–6 (2 pls.).
See also *Bot. Centralbl.*, civ. (1907) p. 579.

SHEAR, CORNELIUS LOTT—**New Species of Fungi.**

[Most of them were found on species of *Vaccinium*. The new genera estalished are, *Plagiorhabdus* and *Bothrodiscus* (Sphæropsidales), and *Acanthorhynchus* (Pyrenomycete).]

Bull. Torrey Bot. Club, xxxiv. (1907) pp. 305–17.

SPESCHNEW, N. N.—**Mycologische Bemerkungen.** (Mycological observations.)

[Several fungi are carefully described.]

Monit. Jard. Bot. Tiflis, 1906, pp. 10–15 (1 fig.).
See also *Ann. Mycol.*, v. (1907) p. 299.

STIFT, A.—**Mitteilungen über im Jahre 1906 veröffentliche bemerkenswerte Arbeiten auf dem Gebiete der Zuckerrüben und Kartoffelkrankheiten.** (Communications on work done in 1906 on beet and potato diseases.)

[A summary of the various diseases recorded on these plants.]

Centralbl. Bakt., xix. (1907) pp. 289–310.

SUMSTINE, DAVID R.—**Polyporus pennsylvanicus sp. n.**

[A description of the new species, and comparison with related forms.]

Journ. Mycol., xiii. (1907) pp. 137–8.

WACHTER, W.—**Zur Kenntnis der Wirkung einiger Gifte auf Aspergillus niger.** (The knowledge of the action of certain poisons on *Aspergillus niger*.)

Centralbl. Bakt., xix. (1907) pp. 176–84.

ZELLNER, J.—**Ueber das fettspaltende Ferment der höheren Pilze.** (The fat-splitting ferment of the higher fungi.)

[The process is described, but the ferment has not been isolated.]

SB. k. Akad. Wiss. Wien. Math.-Nat. Kl., Abt. 2, cxv. (1906) pp. 119–28. See also *Ann. Mycol.*, v. (1907) pp. 311–12.

Lichens.

(By A. LORRAIN SMITH, F.L.S.)

Lichens of Dalmatia.*—A. Zahlbrückner gives an account of collections made by several workers in various parts of Dalmatia, the most important being from the mountainous country between Spalato and Sinj, a district hitherto unexamined lichenologically. Most of the species are such as grow on chalk formations; in the higher regions distinctly alpine forms were met with. The peculiar form of *Parmelia saxatilis* var. *contorta* was accounted for by the moisture in the atmosphere and the prevalence of high winds.

* Oesterr. Bot. Zeitschr., lvii. (1907) pp. 19–30 and 65–73 (1 fig.) See also Bot. Centralbl., cv. (1907) pp. 142–3.

Notes on Cladonia.*—Bruce Fink deals in the present paper with three species of *Cladonia*, all of them red-fruited. *C. bacillaris* grows on earth or on old logs or stumps usually in rather open and dry places. *C. macilenta* has a similar habitat, and the two lichens are very much alike; but while the podetia of *C. macilenta* become yellow with iodine, *C. bacillaris* gives no reaction. *C. didyma*, the third species, differs in the character of the squamules, which are minute and laciniate.

Lichen Vegetation of the Sarck Mountain in Swedish Lapland.† The lichens of this region have been worked out by Birger Nilson. He classifies them into those that inhabit the higher altitudes and those that are found on the plains, and also those that live on rocks or on the ground. He found certain species on rocks under the snow and very rarely exposed. These were poorly or abnormally developed, and seemed to be very old plants. The list includes 288 species, a few of them new to science. He has substituted *Parmularia* for the genus *Placodium*, as he does not consider the latter name satisfactory.

Grecian Lichens.‡—A. Zahlbrückner has determined a collection of lichens made by Brilze in Greece, chiefly in Tinos and other islands of the Cyclades, and in some of the Ionian islands. Tinos is composed of granite and serpentine rocks; the other localities are of chalk formation. He finds that the lichen flora of Tinos resembles that of Constantinople and Scutari. He concludes that a similar vegetation would be found all round the coast of the Ægæan Sea.

BRITZELMAYR, MAX.—**Die Gruppen der Cladonia pyxidata L. und Cl. fimbriata L.** (The groups of *Cladonia pyxidata* and *Cl. fimbriata*.)
[The author has made a special study of the chemical reactions of a number of related forms.]
Beih. Bot. Centralbl.; xxii. (1907) pp. 231-40.

„ „ **Neues aus den Lich. exs. aus Sud Bayern n. 742-847.** (Novelties in the Lichen Exsiccata of South Bavaria.)
Tom. cit., pp. 331-8

FINK, BRUCE—**Further Notes on Cladonias. XI. Cladonia pyxidata and Cladonia pityrea.**
[Descriptions of these species, and notes as to their locality, etc.]
Bryologist, x. (1907) pp. 57-60 (1 pl.).

HARRIS, CAROLYN W.—**Lichens of the Adirondack Club Tract.**
[A list of 60 Lichens from Herkimer County, New York.]
Bryologist, x. (1907) pp. 64-6.

ZAHLBRUCKNER, A.—**Die Flechten der Deutschen Sudpolar Expedition, 1901-3.** (Lichens of the German South Polar Expedition.)
[Plants are described from Cape Verde Island, Ascension, Cape of Good Hope, Kerguelen, Heard Island, and Gaussberg.)
Deutsche Sud-Polar Expedition, 1901-3, viii. (Bot.) pp. 19-55, taf. iii.-v., 4to. Berlin: Reimers, 1906.
See also *Bot. Centralbl.*, cv. (1907) pp. 198-200.

* Bryologist, x. (1907) pp. 77-9 (1 pl.).
† Natwiss. Unters. Sarckgebirges in Schwedisch Lappland. Stockholm and Berlin, 1907, iii. (Bot.) pp. 1-70. See also Bot. Centralbl., cv. (1907) pp. 309-11.
‡ Hedwigia, xlvii. (1907) pp. 60-5.

ZOPF, W.—**Zur Kenntniss der Flechtenstoffe.** (The knowledge of Lichen constituents. Sixteenth contribution.)
[A number of new acids have been isolated.]
Liebig's Ann. Chemie, ccclii. (1907) pp. 1–44.
See also *Bot. Centralbl.*, cv. (1907) pp. 143–5.

Schizophyta.

Schizomycetes.

Two New Purple Bacteria.*—H. Molisch describes two new purple bacteria: 1. *Rhodocapsa suspensa* appeared in a glass vessel containing seaweed, a dead crab or star-fish, and sea-water from Trieste, that had stood in full daylight for some months, the water being stained a rose-red colour. If examined in sea-water, no trace of a capsule is visible, but if Indian ink is allowed to flow under the cover glass, a colourless halo is seen to surround each of the bacteria. The organisms vary greatly in length from 3·5 μ to 180 μ, being usually 10 μ to 20 μ; they appear as rods or as more or less curved threads, in which are seen curious highly refractile bodies, that give an irregularly segmented appearance to the cytoplasm. The organism can be stained by aqueous solutions of aniline dyes, and the capsule stains well with Peppler's flagella method. In the swarming state when the capsules are absent, the bacteria show active motility, but in the resting capsuled state this is not seen; spore formation was not observed. The refractile bodies, which the author refers to as "airosomes" ("Schwebekörpchen"), disappear on pressure and on drying, and by the action of the vapours of alcohol, chloroform, ether, etc., and of weak solutions of alkalies and acids. These bodies are distinct from sulphur granules. which can also be detected in these bacteria.

2. *Rhodothece pendens* appeared in a vessel containing marine algæ and sea-water from Heligoland, that had stood in the daylight for six months, the fluid having acquired a rose-red colour. Examined by the Indian ink method referred to above, it was found that each bacterium was surronnded by a round or elliptical colourless halo. The cells contained sulphur bodies and red highly refractile airosomes like those seen in *Rhodocapsa*. The organism appeared as a large round coccus, giving rise on division to diplococci and short chains; the cells without their capsules varied from 1·8–2·3 μ in diameter. Active motility was never observed.

Nitrogen-fixing Organisms in the Sea-water of the Gulf of Naples.†—W. Benecke disproves the assertion of A. Nathansohn that nitrifying and nitrogen-fixing organisms do not occur in the water of the Gulf of Naples, and that therefore the part that these bacteria are considered to take in the metabolism of the sea has no existence. The author obtained samples of water from the sea bottom, at depths varying from 20 to 100 m.; these were added to sterile nutrient solutions containing 1 to 2 p.c. mannite, and 0·02 p.c. potassium phosphate

* Bot. Zeit., xii. (1906) p. 31.
† Ber. Deutsch. Bot. Gesell., xxv. (1907) p. 1.

dissolved in pure filtered North Sea water. After three days in a thermostat at 30° C., in a large number of the tubes, typical *Azotobacter* was developed, besides various small bacteria, spirilla, etc.

Nitrogen Bacteria in Sea-water.*—P. Thomsen found nitrite bacteria in all samples of sea-water taken from the surface of the sea bottom. The presence of nitrate bacteria seems to depend on the proximity to land at which the sample is taken, since samples of slime taken from a greater distance from land, when added to nitrite nutrient solution, gave negative results, but in cultures from samples taken at distances nearer to land changes from nitrite to nitrate had occurred.

Pseudo-tuberculosis in Frogs.†—L. Vincenzi describes a short, non-motile, non-sporulating, potential anaerobic bacillus; surface colonies on gelatin resemble those of *B. coli*, and on solid media at room temperature the colonies have a strong odour of garlic. The author has named the organism "*Bacillo opale agliaceo.*" Pathologically it resembles Pfeiffer's bacillus, but its action is more virulent. Frogs were injected subcutaneously and also intraperitoneally, and after varying intervals the animals died, the postmortem appearances presenting pseudo-tuberculous deposits in the liver, spleen, and in some cases also in the kidney, from which the organism was re-obtained in pure culture.

Coccus anomalus and "Vins Bleus." ‡—E. Manceau, referring to the paper of Mazé and Pacottet who find that "le bleu" is due always to one microbe, which they named "*Coccus anomalus*," insists that there is not one "maladie du bleu," but several due to various causes, viz., chemical precipitation from cold, the filling up of a bottle with a wine of a higher alcoholic value, and sometimes from microbial causes, there being many kinds of microbes simultaneously present. The author often met with wines affected with this disease when studying the development of grease ferments both in sparkling and non-sparkling champagnes. The author has isolated from "vins bleus" four microbes —two kinds of cocci, a bacillus, and a sarcina—and he concludes that the "bleu microbe" is not one but many microbes which are often associated.

Differentiation of Bacillus coli and Bacillus typhosus by their action on Inosite. §—G. Meillere finds that in anaerobic cultures neither *B. coli* nor *B. typhosus* have any action on inosite, but under aerobic conditions, this alcohol is rapidly destroyed by *B. typhosus* though not affected by *B. coli*. Organisms which readily attack inosite under ordinary conditions do so no longer if the medium is deprived of oxygen. The author gives details of the medium and the methods he employs for arriving at his results.

Specific Antibody for Micrococcus melitensis.‖—A. Sicra has demonstrated the presence of a specific antibody in the serum of animals

* Ber. Deutsch. Bot. Gesell., xxv. (1907) p. 16.
† Centralbl. Bakt., 1te Abt. Orig., xliv. (1907) p. 391.
‡ Comptes Rendus, cxlv. (1907) p. 352.
§ C.R. Soc. Biol. Paris, lxii. (1907) p. 1096.
‖ Tom. cit., p. 1045.

vaccinated with the *Micrococcus melitensis*, and also in the serum of patients suffering from this disease. Serums of the immunised animals and of patients at different stages of the disease, were heated to 56° C. for 30 minutes, and 9–18 drops were mixed with 2–4 drops of alexic fresh guinea-pig serum, and 5–10 drops of a homogeneous emulsion of *M. melitensis* from a 4-day old agar culture in salt solution; after 5 hours at ordinary temperature there is added to the serum mixture under examination a mixture of 1 part of red corpuscles of a rabbit and 2 parts of hæmolytic serum of a guinea-pig, previously heated to 56° C. for 30 minutes, this last being obtained by the repeated injection of guinea-pigs with defibrinated rabbits' blood. Controls with normal and other serums were made. A positive reaction showed an agglutination of the red corpuscles and complete clearing of the serum; with a negative reaction a hæmolysis of the corpuscles occurred.

Bacteriology of Broncho-pneumonia following Whooping Cough.*—P. Reyher finds in the upper respiratory passages and pharynx in cases of whooping cough an excess of large polar-stained bacteria, and a less number of rods resembling the influenza bacillus. Examination of the sputum at different stages of the disease showed that the large polar-stained rods were found free and in clusters only in the catarrhal state until the commencement of the paroxysmal cough, and that during the convalescent state these rods were inclosed in the flat epithelium. The author considers that these polar-stained rods have an etiological bearing on the disease. The rods vary from 0·3–0·4 μ by 0·8–1·0 μ; on ordinary nutrient media they develop with difficulty, forming small round transparent colonies; gelatin is not liquefied; broth is not clouded but shows a sedimentary growth. The specificity of the organism has, however, not been established.

Bacillus Pathogenic to Fish.†—L. H. Marks found that the death of a number of fish in a laboratory aquarium was caused by an actively motile short stout bacillus. It stains readily, but not by Gram's method; in the animal body there is a distinct capsule; it grows well at 37° C. and 22° C., slowly at 10° C.; colonies on agar have a soft consistence and even contour, and a dirty yellowish white colour; it grows on all media, liquefies Loeffler's serum at 37° C., and gelatin at 22° C.; colonies on Endo-agar are pale pink and later red and without metallic sheen; glucose is fermented but not lactose; sterile milk is coagulated within 3 days with an alkaline reaction; indol is formed in broth. The organism was isolated in some cases from the heart blood; but more often from the spleen and bowel. It is very virulent: 0·5 c.cm. of a mixture of 5 loopfuls of heart blood in 1 c.cm. of broth was fatal for mice within 6–8 hours, a pure culture being recovered from the heart blood of the mouse. The bacillus produces a hæmolysin; the germ-free filtrate is strongly toxic for small animals.

Mineral Requirements of Bacteria.‡—W. Benecke has studied the mineral requirements of *B. chitinovorus*, *B. fluorescens liquefaciens*, and

* Centralbl. Bakt., 1te Abt. Orig., xliv. (1907) p. 493.
† Tom. cit., p. 370.
‡ Bot. Zeit., xiii. (1907) p. 1.

B. pyocyaneus, and obtained good growth and a formation of pigment on a medium composed of asparagin 0·2 p.c., magnesium sulphate 0·05 p.c., potassium sulphate 0·02 p.c. The author found that an addition of 0·05 p.c. of ferrous sulphate to this medium stopped growth almost entirely, and that the addition of 0·002 p.c. permitted growth, but prevented pigment formation; probably iron is necessary for growth, but that which exists as an impurity of the medium is probably sufficient, and may be regarded as negligible, and he concludes that the above medium is sufficient. By substituting the magnesium sulphate for potassium sulphate only a diminished growth was obtained, and no growth occurred unless the medium was free from alkali; when only $\frac{1}{50}$ mg. per 100 c.cm. is added, growth and pigment production are less than when larger amounts are added, and with smaller amounts only cloudiness of the medium occurs, and without production of pigment. The author concludes that potassium is necessary for the growth of these organisms, since similar results were obtained by substituting salts of lithium, ammonium, and rhubidium for the potassium salt. In a similar way the author has shown that the presence of magnesium is necessary for the growth of these organisms.

Bacillus minimus mammæ.* — C. Gorini gives the cultural and morphological characters of a bacterium isolated two years ago from the teat of a cow made sick by bad milking. It is a very minute bacillus found in milk cultures in pairs, short chains, and small aggregations. It is non-motile, and does not form spores. It stains with the usual aniline dyes, but not by Gram's method. It grows only anaerobically. The colonies are more or less rounded. Milk is coagulated with formation of acid, and the production of a presamigenous (rennet) peptonising ferment.

* Rend. R. Istit. Lombardo, xl. (1907) pp. 947–52 (2 figs.).

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

Voigtländer and Sons' Dissecting Stand.†—Fig. 109 shows this large dissecting stand, which is fitted with round horse-shoe foot, rectangular stage 95 × 108 mm., transparent glass stage and revolving

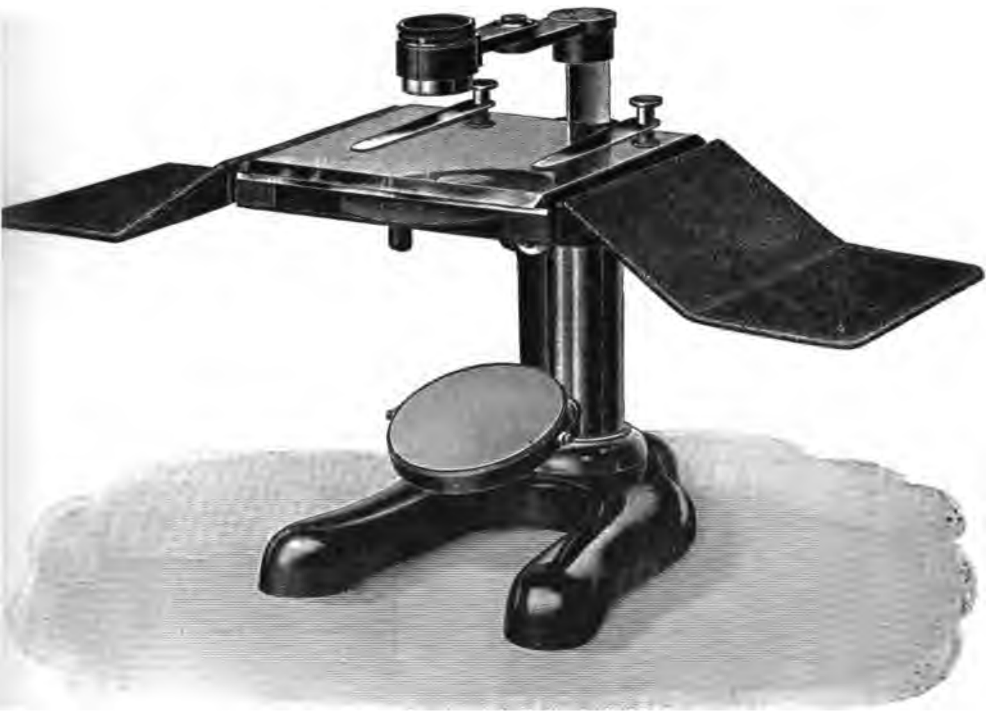

Fig. 109.

diaphragm. The focusing is by rack-and-pinion, and there is a double movable magnifier holder. The mirror is double, 55 mm. in diameter. The hand-supports are leather covered.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.
† Catalogue (English Edition) 1907, p. 39.

Voigtländer and Sons' Stand VIIa.*—This small stand (fig. 110) inclines to 45° and has a movable vulcanite stage 90 × 170 mm., re-

FIG. 110.

volving diaphragm, mirror 55 mm. diameter, and rack-and-pinion focusing adjustment.

Voigtländer and Sons' Hand Microscope for School and Demonstration.†—This is a cheap Microscope for class demonstration (fig. 111).

FIG. 111.

The focusing is done with the eye-piece tube. There is a rectangular stage and revolving diaphragm.

Voigtländer and Sons' Stand I.‡—This large model is shown in fig. 112. It has complete inclination, rack-and-pinion coarse-adjustment, and new micrometer focusing with division of the milled head in 0·002 mm. The wide outer tube is of 50 mm. and the large mechanical stage of 130 mm. diameter. The Abbe illuminating apparatus has a swing-out condenser (N.A. 1·40), iris diaphragm for oblique illumina-

* Catalogue (English Edition) 1907, p. 37. † Tom. cit., p. 38.
‡ Tom. cit., p. 25.

tion, and a double mirror of 55 mm. diameter. The whole illuminating apparatus is moved by rack-and-pinion motion, and remains perpendicular to the stage of the Microscope. There is a revolving nose-piece for three objectives.

Voigtländer and Sons' Stand IVa.*—This stand (fig. 113) has inclination to 45° only, and is fitted with a handled tripod foot. There is

Fig. 112.

Fig. 113.

a rack-and-pinion coarse-adjustment. The older form of micrometer fine-adjustment with division of the milled head in 0·01 mm. is used. The outer tube is 30 mm. in diameter and has a sliding draw-tube. The rectangular vulcanite stage is 85 × 95 mm. and the double mirror is 50 mm. diameter. There is a revolving triple nose-piece. The condenser is ordinary (N.A. 1·20) with fixed iris diaphragm, four diaphragms, and carrier for a blue or ground glass disk. The condenser has a side-screw adjustment.

Fig. 114.

Voigtländer and Sons' Magnifiers.†—Their Steinheil loups are made in six powers, viz.: 7·5, 10, 12, 18, 25, and 35. They may also be obtained in clasp mountings and fitted with a micrometer divided in 0·1 mm. (fig. 114).

* Catalogue (English Edition) 1907, p. 32. † Tom. cit., pp. 14, 15.

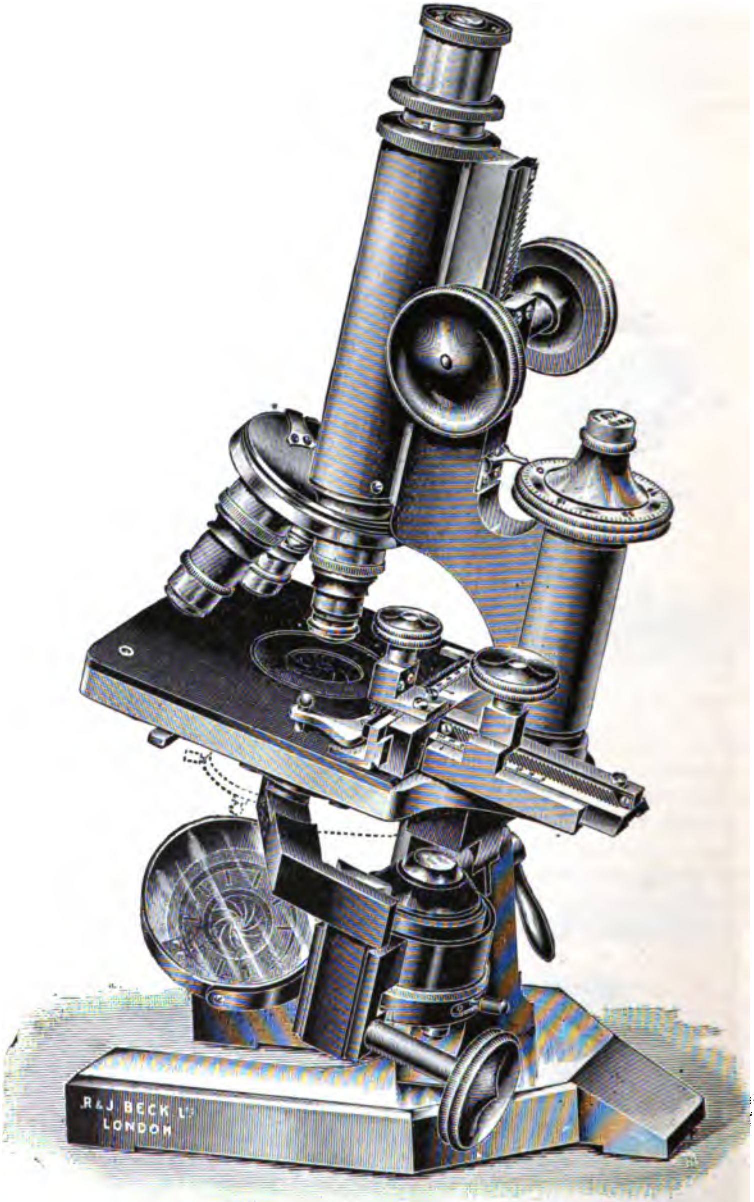

FIG. 115.

Beck's London Microscope: Iris Model.* — In this new model (fig. 115) of the London Microscope † there are the following improvements and additions: a clasp handle for the inclining joint; more room between the stage and the base; an iris diaphragm to the stage; and an arrangement whereby the substage can be swung aside, so that the condenser can be instantly displaced from the optic axis by means of the same milled head which actuates the focusing adjustment. As soon as the condenser has been racked down to its lowest limit, it swings clear of the stage.

(2) Eye-pieces and Objectives.

Koristka's $\frac{1}{12}$ Oil-immersion Objective.‡—The focal length of this has been reduced to 1·80 mm., and thus a higher magnification is obtained. The objective is adapted for the most diverse purposes. While the instrument is equal in effect to a $\frac{1}{14}$ inch, the old denomination has, for simplicity, been retained. It is made with N.A. of 1·30 or 1·37.

Koristka's New Objective 6*.—This, numbered as above,§ has a focal length of 4·3 mm. and N.A. 0·82. It resembles No. 6 in the same maker's series, which has the same focal length, but N.A. 0·72. Its frontal distance is 0·50 mm., and both act as objectives of strong penetration, being very useful in such matters as the computation of the red and white blood corpuscles. The new objective, however, acts better in those researches in which a higher power of resolution is required, e.g. the cases of diatoms.

Voigtländer and Sons' Objectives.‖ — The construction of the apochromats is shown in fig. 116. They are absolutely free from chromatical aberration; hence their applicability to microphotographic work and the finest and most difficult examinations. Among their new lenses of this class are those of focal lengths, 12 mm., 6·5 mm., and 3·7 mm.; with respective N.A. 0·5, 0·75, 0·95.

Fig. 116.

The achromatic objectives of the dry systems have low optical indices, the highest being that of 16 mm. focal length and 0·28 N.A.

The firm have brought out a new water immersion achromat of 5 mm. focal length and N.A. 0·75; and a new oil-immersion of 2·7 mm. and N.A. 0·35.

Voigtländer and Sons' Eye-pieces.¶—These include four Huyghenian eye-pieces of magnifications 5·5, 7·5, 9·2, 11·4; and five compensating eye-pieces of powers 6·2, 8·3, 11·4, 16·7, 25·0.

* R. and J. Beck's Special Catalogue, 1907.
† See this Journal, 1901, pp. 694–5, fig. 145.
‡ Supplement to General Catalogue, N 12, Milan, April, 1907. § Loc. cit.
‖ Catalogue (English edition) 1907, p. 7. ¶ Tom. cit., p. 11.

Voigtländer and Sons' Screw-micrometer Eye-piece.*—Fig. 117 shows this auxiliary in section and end elevation. It is intended for the most exact measurements, and contains a carefully cut screw moving a

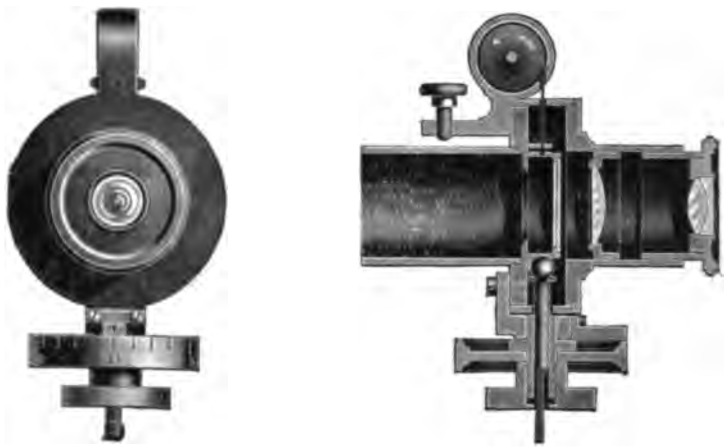

FIG. 117.

glass scale divided in millimetres. The parts of division on the drum are 0·01 mm., and therefore measurements of 0·001 mm. are obtained. The apparatus is placed in the tube in lieu of the ordinary ocular.

"H."—**Eye-pieces of the Huyghenian or Negative Type as corrected for Achromatism and Equal Deviation at the Lenses.**

[Among other things it is shown that in practically constructing a telescope eye-piece, it is necessary to depart widely from Huyghen's formula, the only one discussed in text-books.]

Eng. Mechanic, lxxxv. (1907) pp. 567-9 (6 figs.); pp. 588–9, 612–13.

(3) Illuminating and other Apparatus.

Simultaneous Projection of Two Different Preparations in the Field of the Microscope.†—F. K. Studnicka's "pancratic" Microscope has been noticed in this Journal,‡ and the author now describes how it may be advantageously employed for simultaneously viewing two different preparations. One of his pancratic methods involved the accurate insertion of a reverse objective in the diaphragm-carrier of the Abbe illuminating apparatus from which the condenser had been removed. On a special stage below the ordinary one, a preparation is placed which comes into focus as a reduced reverse image not far from the plane of the ordinary stage, and can be observed in the usual manner. If another preparation be now arranged on the upper stage, the two objects can be brought into simultaneous view, the lower object being racked up or down as required. If the sizes of the objects are large,

* Catalogue (English edition) 1907, p. 42.
† Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 34–8.
‡ See this Journal, 1905, p. 643.

then only portions of them can be simultaneously seen. In this latter case, however, comparison may be easily made if one of the stages be adapted for swinging out of the field. The method, which is naturally only adapted to transparent preparations, succeeds best with low-power objectives, for the difference in the magnification of the two objects might be inconvenient with strong lenses. The oculars employed should be weak and not too intensive. If the Abbe condenser is used, its iris should be as much as possible closed. The author recommends the arrangement not only for subjective observation, but also for photomicrography.

Simple Method of Adjusting the Nicols in a Mineralogical Microscope.*—In order to provide a cheap and trustworthy means of accurately determining whether the nicols of a mineralogical Microscope are in a perfectly crossed position, E. Sommerfeldt proposes the use of a twin crystal of gypsum. This crystal would be applied to the slit, and, owing to its extreme fissibility, it would be easy to obtain it in the required degree of thinness. Such a crystal plate must be so applied that in the rotation of the object stage, a position is found in which both members of the twins appear equally bright. The twin limit then accurately coincides with a thread of the thread-cross when the Microscope is properly adjusted—otherwise the adjustment must be corrected until this condition is attained. If the preparation is then rotated 45° either way in its plane, a second position of equal brightness in the twins is found. In this way those positions can be noted, or tested, which are usually indicated on the tube of an expensive mineralogical Microscope.

Siedentopf's Paraboloid Condenser: a New Method for Dark-field Illumination.†—This apparatus of H. Siedentopf's is especially adapted for securing visibility of living bacteria (especially of *Spirochæta pallida*), and for their instantaneous photography. From the optical standpoint *Spirochæta pallida* is characterised less by its spiral form than by its extreme thinness, which usually lies below the resolution-limits of microscope objectives. While, no doubt, large specimens can be seen with bright-field illumination, the observer will experience greater difficulties and obtain less satisfactory results than with dark-ground effects. But for dark ground the objective must have deeper penetrating power in consequence of the greater contrasts; while, on the other hand, owing to the naturally increased resolution of high aperture with oblique light, moderately strong systems of 7–4 mm. focus suffice, one effect being to produce a larger and more extensive view-field. In contrast with these advantages, dark-ground illumination has the disadvantage of increasing the difficulties due to any deficiency of cleanness in the preparation, or to dust on the cover-glass. Ultramicroscopic methods are not required for revealing living bacteria. A very simple and successful dark-ground illumination of another kind is obtained by inserting a diaphragm of 24 mm. diameter under the immersion condenser of 1·4 N.A., the object-slide being connected with the condenser

* Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 24–5.
† Tom. cit., pp. 104–8 (1 fig.).

by cedar-wood oil. In consequence of the total reflexion at the cover-glass, a very useful dark ground can be obtained with dry systems.

The author's paraboloid condenser (fig. 118) is an improved form of Wenham and Stephenson's, and can be fitted on to every Microscope which possesses a condenser push-sleeve of ordinary width (36·8 mm.). It is inserted in the position of the condenser sufficiently far to bring its upper plane approximately to the level of the stage, and a cedar-wood oil connexion, as far as possible bubble-free, is made between the under side of the slide and the condenser. The thickness of the oil-layer is 1·0 to 1·5 mm. The illuminating beams have a N.A. of about 1·1 to 1·4 and are totally reflected at the upper plane of the cover-glass in contact with air. The paraboloid has improved spherical correction; but its main advantage is that it reflects the rays instead of refracting them. Dry systems of medium strength are used, Zeiss DD with correction-collar being the most suitable. The best results

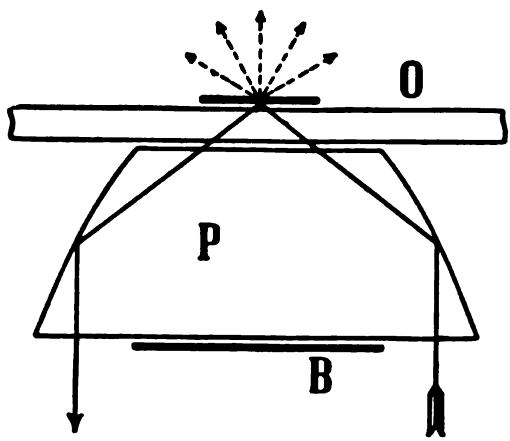

FIG. 118.

are obtained when this objective is screwed on to the tube with a small centring arrangement; the focus of the paraboloid can then be made to coincide with that of the objective. Strong compensation oculars (No. 12 or 18) complete the optical equipment. Incandescent mantles, Nernst-light, or, best of all, electric arc-light may be used. Sunlight, or arc-light with this condenser, is sufficiently intensive for the instantaneous photography of living bacteria. The path of the rays in the paraboloid is shown in the figure, those refracted in the object itself being dotted. P is the plano-convex glass whose convex curve is an accurate paraboloid of revolution. B is the central diaphragm, which stops off rays of aperture 0·0 to 1·1; it is covered with tin-foil to prevent over-heating. O is the object-slide, and in its upper surface is the focus of the paraboloid. There are no diffraction circles apparent when central illumination is used; and, if the adjustment is carefully performed, a living *Spirochæta* may be seen in five different typical appearances.

Dark-field Illumination and Ultramicroscopy.* —The first two out of the three sections of this article are devoted by H. Siedentopf to methods which are substantially those noticed in our abstract immediately above. In his third section he discusses the examination of colloidal solutions, serum, and drinking water. He points out that the difficulties caused by the tendency of the ultramicrons to collect on the underside of the cover-slip, or on the upper side of the object-slide, include not only diffraction but those due to currents set up by variations in the concentration. All these difficulties are avoided if an arrangement be adopted similar to that used by Siedentopf and Zsigmondy in their original ultramicroscopic experiment, whereby the directions of illumination and observation are mutually perpendicular. The best test object for this method is a deep red colloidal gold solution, whose parts appear green on a bright ground, with a strong water-immersion objective (Zeiss' D✱) and strong ocular (Zeiss' compensation ocular 12 or 18). This method is the only one suitable for the examination of ultramicrons in solid bodies, e.g. glasses and crystals. Direct observation of such objects would require the preparation of very thin, highly polished sections, and it is found that the light-effects from the polishing errors drown out the other effects. The author states that he has never succeeded in resolving the gold particles of ruby gold glass by direct observation with dark-field illumination.

Measurements of some Modern Micrometers.†—From a preliminary study of some modern micrometers, M. D. Ewell arrives at the conclusion that no advance in precision has been made in the last twenty-five years. The measurements of the different scales are given.

Microscope Lamp.‡—" Antares " remarks that for ordinary investigation, when daylight is past, an electric lamp is more clean and convenient than any other; but for " critical " observation its usual form is not successful. His consists of a metal cylinder 2½ in. diameter and 6 in. long; the aperture is at the top, under an inclined cover, so that the incandescent lamp is not visible, and it is painted a dead white inside, giving a " white cloud " effect. The cylinder can be inclined at any angle, and is adjustable for height from the base by a racked pillar and pinion. In the back of this cylinder, about the middle, he has now made a longitudinal slit, ½ in. long and $\frac{1}{16}$ in. wide (rather narrower might be better), which can be brought, by rotating the lamp-socket, opposite to one of the straight parallel filaments of a tubular Edison-Swan lamp of 2½ c.p. and 100 volts, so that ½ in. of filament glows through the slit. When the lamp is used in this way the ordinary aperture of the cylinder is closed by a bent card, and the illumined slit is brought by movements of the lamp-stand into line with the axis of a substage condenser. The effect is thus similar to that of a small paraffin flame placed edgewise, but more constant, and, he thinks, quite as successful.

* Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 13–20.
† Proc. Amer. Phil. Soc., xlvi. (1907) pp. 187–90.
‡ English Mechanic, lxxxvi. (1907) p. 42.

Cheshire's Apertometer.* — This instrument (fig. 119), made by R. and J. Beck, consists of a glass disk with a series of concentric rings in its lower surface. The object-glass to be tested is focused to a mark on the upper surface, and, the eye-piece having been removed, the

FIG. 119.

FIG. 120.

number of rings seen in the back lens of the object-glass gives the aperture in decimals, each ring denoting 0·1 N.A.

For high powers, when the lens is small and the rings difficult to count, a special eye-piece (fig. 120), which focuses to the back focal-plane of the object-glass, is required. This is inserted in place of the usual eye-piece.

Edinger's Drawing and Projection Apparatus.—This apparatus, which has more than once been noticed in our Journal,† has been recently revised and improved.‡ It is shown in figs. 121–125, of which fig. 122 illustrates the principles of construction and is lettered for reference. The apparatus is primarily intended for facilitating the work of preparing drawings of microscopic objects and is available for comparatively high magnifications. To this end the image of the object is projected directly upon the drawing surface where it may be traced with a lead pencil. The instrument is likewise adapted for demonstrating to a small audience objects on the screen and for photomicrography. The apparatus consists of a cast-iron column S mounted upon a rectangular frame in which the drawing-board Z is made to slide in or out. The column S is provided with a guide-bed along which the entire optical outfit, together with the lamp, can be made to slide up and down after loosening the screw R. The movable part B has likewise guide-bars for the independent displacement of the lamp L, object stage O, and lens-holder H. The lamp, together with the condenser K, may be displaced along the optic axis by means of the handle G. The object stage O may be raised or lowered, as required, according to the objective used, and its position is shown on a scale divided into ½ cm. The lens-holder H remains fixed at a distance of 1 cm. from the lower end of the guide-bar, and should not be detached excepting during the removal of the apparatus. The object-stage carries the condenser K_2. The latter consists of two lenses, either of which may be employed separately, in addition to which the condenser may be swung aside. The iris dia-

* R. and J. Beck's Catalogue of Microscopical Apparatus, 1907, p. 6.
† See this Journal, 1905, p. 650; 1891, p. 811.
‡ Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 26–34 (5 figs.). See also Leitz' Special Catalogue (Wetzlar) English edition.

phragm, situated above the condenser, is provided for work with high-power objectives. The specimens are placed upon the stage and fixed thereon by means of clips, care being taken that the cover-glass is turned

FIG. 121.

downwards so as to face the objective. The stage is provided with interchangeable stops of graded apertures, and the lens-holder has an adapter for the accommodation of a nose-piece ; also an adapter for microsummar

projection lenses. The Microscope-tube T slides into the sleeve attached to the lens-holder. When the distance of the fine-adjustment micrometer screw exceeds a convenient limit, as in fig. 124, the focusing gear supplied

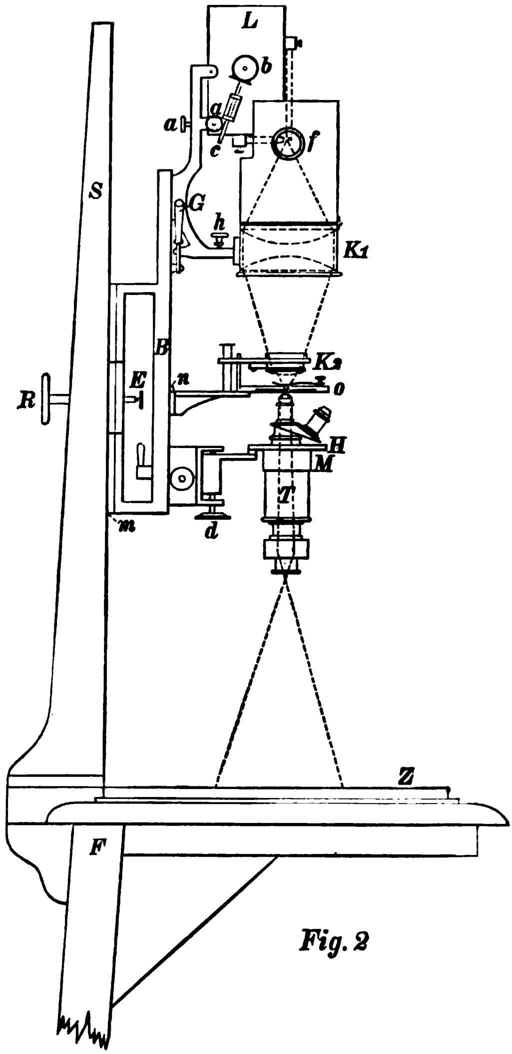

FIG. 122.

with the apparatus should be attached. The hand-regulated lamp requires a 4-ampere current, and has its carbons inclined at 90° to each other, the positive carbon being held in the direction of the optic axis.

Lamps for alternating currents may also be adapted. The lamp is provided with a rheostat for 110 volts. The two screws a_1 *a* serve to direct the crater accurately into the optic axis of the apparatus. The screw *b* is for feeding the carbons. When the lamp is at the top of the apparatus (fig. 121), the carbons may be regulated by a flexible rod affixed at *c*. The position and working of the carbons may be watched through the window *f*. For work in a lighted room, the apparatus is provided with a cloth screen attached to a hinged ring of wood, which can be made to envelop the condenser K, and secured by means of a screw *h*. When the apparatus is required for projection, the locking arrangement E

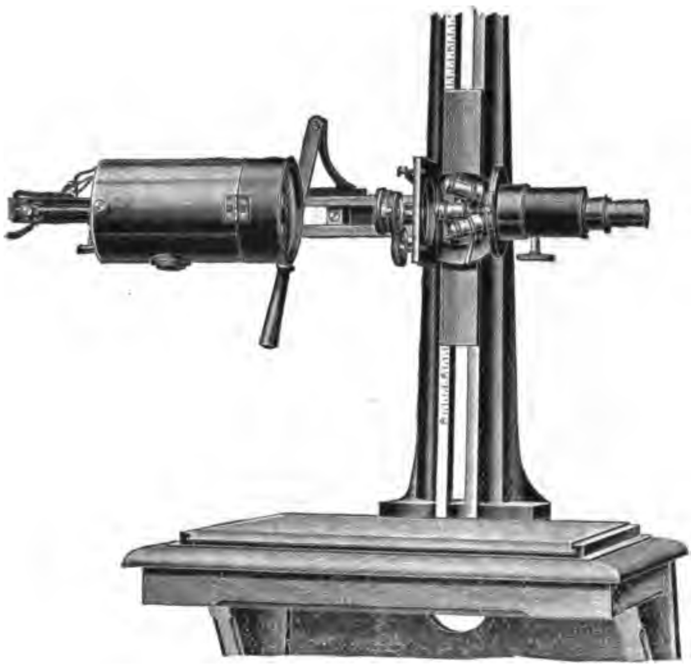

FIG. 123.

should be released, and B together with its optical equipment turned about the horizontal spindle R, until E fixes the optical axis in a horizontal position (fig. 123). Photomicrographs are prepared with the aid of a camera fitted with a dark slide available for plates up to 30 × 40 cm. The camera with the dark slide downwards should be placed upon the drawing board and attached to the column S. After adjusting the part B, the camera end should be moved upwards until the sleeve at the camera end incloses the sleeve attached to the draw-tube of T, or sleeve M when a microsummar is being used. This insures a light-tight connexion between the two parts. For sharp focusing, the bellows may be detached from the dark-slide holder (fig. 124). The image

appears then on a paper screen which may be slid in after the manner of a ground-glass focusing screen. The distance from the eye-piece to the

Fig. 124.

drawing surface may be measured by means of a wooden set-square, which forms part of the apparatus. By raising B to the extreme top

and placing it horizontally, sufficient room is obtained to fix the camera to the column S in an inverted position, i.e. with the dark slide upwards.

Fig. 125.

In this position the camera is available for the photography of opaque objects placed upon the drawing board Z. The entire apparatus may be

set up on any table, but a special stand F has been designed for the purpose (figs. 122 and 125). This stand has the advantage that, after the removal of the drawing-board Z, a more highly magnified drawing may be made on the lower table-top. Also that, owing to its greater height, it is better adapted for projection on the screen.

(5) Microscopical Optics and Manipulation.

Polarisation of Refraction and Propagation of Light in a Medium Non-homogeneous.*—C. Fabry discusses the observations of Salet, who failed to detect evidence of polarisation in the light emitted from the solar protuberance, as reported by certain astronomers. The passage of a ray refracted through a series of media of progressive indices of refraction is evidently connected with the reflections which would take place at the successive surfaces and which might result in some polarisation of the ray. The author's experiments tend to support Salet's observations.

HARTL, H.—**Ein Modell zur Erläuterung der Zerlegung eines linear polarisierten Lichtstrahls bei der Doppelbrechung.** *Zeit. f. Unterricht.*, xix. (1906) p. 175.

KOERBER, F.—**Ein Freihandversuch zur Bestimmung der Brechungsexponenten des Glases.** *Tom. cit.*, p. 167.

(6) Miscellaneous.

Brownian Movement in Gases: its Visibility through an Ordinary Microscope.†—F. Ehrenhaft has observed the above phenomenon by the aid of an ultra-Microscope; but H. Molisch has found that in many cases the use of an ordinary Microscope with weak objectives suffices to render the Brownian movement visible, even with

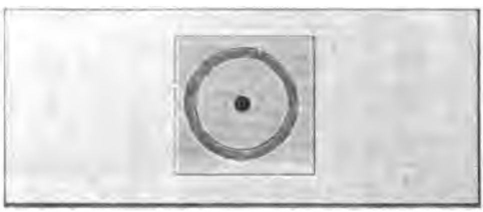

FIG. 126.

ordinary illumination. A glass ring, about 12 mm. inner diameter and 3–5 mm. high, is cemented on to a glass slide (fig. 126). On the lower surface of the slide and accurately at the centre of the ring, a circle of Indian ink 1–3 mm. diameter is painted, for the purpose of attaining dark-ground illumination. The author uses Reichert's Microscope with objective 3 and ocular 2 (magnification 50–76 diameters), completely removes the collar and stop, and adjusts the black point of the object

* Comptes Rendus, cxlv. (1907) pp. 112-15.
† Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 97-103 (2 figs.).

slide exactly on the centre of the diaphragm aperture. Tobacco smoke is then slowly blown into the chamber formed by the slide and glass ring, the chamber being immediately closed with a cover-glass (fig. 127). In direct sunlight and very oblique illumination the smoke particles then appear as countless white spots on a dark ground and exhibit a dancing or trembling motion similar to the Brownian movement in fluid. The stronger the light source the more visible are the

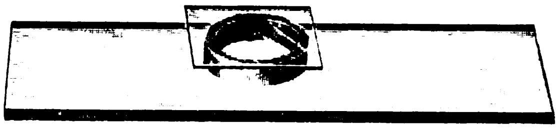

FIG. 127.

particles. They can also be seen with arc-light or incandescent gas, or even with diffused daylight. Although the size of the dark spot stands in a certain proportion to the objective and the distance of the optic plane from the eye, it is possible to obtain the effect without it by merely shading the lower half of the mirror with one's finger, or by interposing a piece of black paper. The appearance of the field resembles that of a star-lit sky. If direct incident illumination be used the object is screened off by a black shade and the sunlight allowed to pass through a small slit 5 mm. broad, being previously concentrated on it by an illuminating lens. The activity of the molecular movement is influenced by the temperature of the particles, but their gradual subsidence, due to gravity, is clearly noticeable under the Microscope. The author experimented with many other vapours, e.g., phosphorus and ammonium chloride. Bodaszewsky, who has also worked at this subject, estimates the diameters of the smoke particles at approximately 0·0002–0·0003 μ, and therefore on the limit of microscopical perception. The author, however, considers that they are in general much larger.

Microscopy: by E. J. Spitta.*—As will be gathered from the brief description of its contents which follows, this book deals in a very complete manner with the Microscope from both the mechanical and the optical point of view, a characteristic feature being the exhaustive treatment of many interesting aspects of the subject which have hitherto been passed over lightly, if treated at all.

An introductory chapter, in which the various forms of simple lenses and their general properties are described, is followed by one dealing with the simple Microscope, which is illustrated in all its usual forms.

Chapters III. and IV. are devoted to the Compound Microscope, all the mechanical details being discussed in the former, whilst the latter describes the optical construction, and is distinguished by the thorough way in which the various "corrections" are dealt with.

* Microscopy: The Construction, Theory, and Use of the Microscope. By Edmund J. Spitta. London: John Murray, 1907, pp. xx. and 468 (17 pls. and 215 figs. in text).

The fifth chapter deals with numerical aperture and depth of focus and gives all information required for ascertaining these important properties of lens systems.

Chapter VI., on Eyepieces, is remarkable for the clear way in which the chromatic correction of oculars is described and illustrated, thus throwing much-needed light on a subject which is much neglected and frequently misunderstood.

Magnification and its limits having next been dealt with, the author proceeds in Chapter VIII. to describe and discuss the substage condenser, and to establish rules for its proper use, the subject being followed up in the succeeding chapter by a description of auxiliary lighting apparatus, such as bullseyes, lamps, heliostats, the author's arrangement for obtaining monochromatic light by a direct-vision Thorpe grating, etc. The question of the proper use of oblique light and of dark-ground illumination is also dealt with, and the chapter closes with a description of polarised light and its use in the Microscope.

Chapter X. describes in great detail the proper manipulation in setting up the instrument and preparing it for practical use, and is, as a matter of course, full of valuable hints.

Binocular Microscopes, in the English as well as in the Continental form, are described in Chapter XI., whilst Chapter XII. deals with the measurement of microscopical objects, the instruments used for the purpose, and the units in which the measurements are usually expressed.

Chapter XIII. contains illustrations and descriptions of many forms of Microscopes, from the simplest to the most elaborate, classified according to the purpose for which they are most useful. This chapter concludes with statements of a large number of well-known microscopists as to the kind of optical outfit which they find most useful for their respective branches of research, statements which should be most valuable to new beginners in these fields.

The fourteenth chapter is one of the best in the book, dealing very thoroughly with the testing of objectives, chiefly by means of the Abbe test-plate, which is so little known in this country, and yet so valuable. The various methods of effecting the chromatic correction are gone into, and minute instructions given as to the methods of determining the state of objectives in this respect as well as with regard to spherical correction.

Chapters XV. and XVI. are contributed by Mr. A. E. Conrady, who here gives a short account of the undulatory theory of light, and of the principal results obtained by applying it to the theory of the Microscope, which latter is treated from an essentially historical standpoint.

A number of accessories of a specialised type, such as metal-holders, spectroscopic attachments, and some of the latest novelties, are described in Chapter XVII.

"Hints" upon common faults and means of cure are dealt with in the last chapter. It is needless to say that some of these hints are very valuable.

Seventeen magnificent photomicrographic plates illustrating the principal test-objects call for special mention, and the very complete index must prove a welcome addition to the book.

Microscopy of Technical Products.*—A. L. Winton, in collaboration with Kate G. Barber, has translated Hanausek's useful and well-known text-book, The Microscopy of Technical Products. After a short description of the Microscope, its accessories, and of micro-technique, the author passes on to the microscopy of the most important types of technical raw material, such as starch, vegetable and animal fibres, stems and roots, leaves, flowers, fruits, and seeds. Most of the volume is devoted to the foregoing, the characters of teeth, bone, and horn being summed up in one short chapter. The last section of the work deals with michrochemical analysis. Hanausek's work is already so well known in its original garb that it seems almost unnecessary to point out that its object is to teach by the aid of the Microscope how to identify technical products, and at the same time to inculcate the fundamental principles of vegetable histology, and the histology of certain animal materials. The translator and his collaborator are to be congratulated on the result of their task, more especially as the present volume is an augmented and revised edition of the last German work. The volume is admirably got up, and copiously and excellently illustrated.

Quekett Microscopical Club.—At the 442nd Ordinary Meeting of the Club, held on October 18, the President, Dr. E. J. Spitta, F.R.A.S., F.R.M.S., in the chair, the following papers were read.

A note by Mr. E. M. Nelson, F.R.M.S., on a new semi-apochromatic ⅛ inch objective computed by Mr. A. E. Conrady, F.R.M.S., and made by Messrs. Watson and Sons; a note on "Three Water-mites new to Britain, *Thyopsis cancellata* Protz, *Sperchon glandulosus* Koen, and *Lyania bipapillata* Thor," communicated by Mr. G. P. Deeley; a note on "Secondary Markings in *Navicula Smithii*," and a note on "Secondary Markings in *Navicula crabro* Ehr. (*N. pandura* Bréb.)," both by Mr. A. A. C. Eliot Merlin, F.R.M.S.; and a résumé by Mr. F. P. Smith of a valuable paper on "British and Foreign Pseudo-Scorpions," by Mr. Edv. Ellingsen, of Kragerö, Norway. The paper gives descriptions, mostly at length, of some 20 species of this order belonging to the genera *Chelifer*, *Chiridium*, *Ideobisium*, *Obisium*, and *Chthonius*.

B. Technique.†

(1) Collecting Objects, including Culture Processes.

Natural Culture of Trichomastix serpentis.‡—C. C. Dobell examined the fluid from the rectum of a rattlesnake dead of canker of the mouth. The fluid, which was brownish, almost odourless and alkaline, was transferred to a glass dish and covered with a thick glass plate fixed down with vaselin. In this fluid the parasites lived for about 120 days, increasing in number for some five or six weeks, when they reached their maximum, afterwards gradually dying out. Attempts to cultivate

* New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1907, xii. and 471 pp., 276 figs.

† This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc. (6) Miscellaneous.

‡ Quart. Journ. Micr. Sci., li. (1907) pp. 449–50.

on artificial media failed. The method of examination was as follows: A few drops of the culture were drawn up in a fine pipette and examined fresh either in a hanging drop preparation or under a cover-slip with wax feet, and waxed round the edges. In this latter condition the animals remained alive for 13 days.

Good permanent preparations were hard to obtain, owing to the small numbers of the parasites and the large amount of gritty foreign substances in the fluid. For successful preparations the stains used were Delafield's hæmatoxylin, Heidenhain's iron-hæmatoxylin, and Giemsa. Observations of the living animal were often facilitated by intravitam staining with neutral red. Brilliant cresylblau and methylen-blue were of little use.

Simple Method of Obtaining an Oxygen-free Atmosphere for Cultivating Anaerobes.*—Stan. Růžička uses a Kipps' apparatus for producing hydrogen, and gets rid of the remaining oxygen with pyrogallol and caustic potash. As indicator he uses a mixture of phenol soda, grape-sugar, and indigo sulphate.

Cultivation of Essential Anaerobes in a Vacuum.†—U. Biffi employs the following apparatus (fig. 128) for the cultivation of anaerobes. This consists of a strong thick-walled Erlenmeyer flask, of 250 c.mm. capacity, closed by a rubber cork, perforated by a short glass tube that extends from the lower surface to about 3 cm. above the top of the cork; this glass tube is inclosed by rubber tubing about 8 cm. long, the further upper end of which holds a short piece of glass tubing about 2 cm. long, and which at its free end is closed by wool.

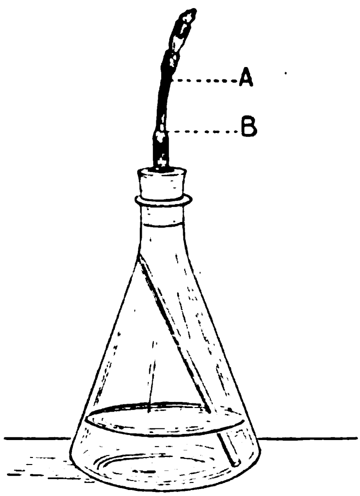

Fig. 128.

The flask is filled to one-third of its height with broth, and into this is plunged a thin glass tube 2–3 mm. in diameter, and long enough to reach from the bottom of the flask nearly to the stopper; this tube is closed at the upper end, and serves as a manometer to indicate the pressure in the flask. The apparatus is then sterilised, and all the tube joints are smeared with Canada balsam. The broth is then slowly boiled, and on the first appearance of small bubbles around the manometer tube, the wool plug is removed from the outer tube. As soon as the steam commences to escape strongly from the opening, the rubber tube is seized with a pinchcock between A and B, and the whole is removed from the heat, and the wool plug replaced. When the apparatus has cooled, it is ready for use. The inoculation from the culture material is effected into

* Archiv f. Hyg., lviii., p. 327. See also Centralbl. Bakt. Ref., 1te Abt., xl. (1907) pp. 308–10.

† Centrabl. Bakt., 1te Abt., Orig., xliv. (1907) p. 280.

the rubber tube between A and B by means of a Pasteur pipette; if the material is solid it is suspended in a small quantity of sterile fluid.

New Method for Closing Cultivation Tubes.*—G. C. Chatterjee states that cotton-wool plugs are not suitable for stopping test-tubes in tropical climates, as they soon get overgrown with fungi, etc. He has found that if the one tube be covered by means of another of slightly larger diameter, and kept in its place by means of a spring attached to a ring on the lower tube, many advantages accrue and the disadvantages are obviated.

New Method for the Cultivation of Anaerobic Bacilli.†—N. Pende and L. Viviani employ an apparatus for the cultivation of anaerobic bacilli, which consists of a small glass tube closed at both ends and containing rarefied hydrogen gas; one end of this tube is drawn out into a fine point; this point is broken under the surface of the culture fluid, some of which is drawn up into the tube, which is now closed again by a flame, and placed in a thermostat.

Aerobic Culture of Essential Anaerobes.‡—A. Wrzosek has found that the substance existing in animal and vegetable tissues that favours the aerobic growth of essential anaerobes was not affected by exposure to high temperatures, but exposure to the air destroyed the active properties of this substance. A series of tubes were taken, each containing 10 c.cm. of ordinary neutral broth, and into each was introduced fresh-cut cylinders of potato or animal tissue weighing 2 grm., and into some of the tubes melted paraffin was then poured; the whole were sterilised at 120° C. for 15 minutes. Some tubes were placed in the dark, and others exposed to the action of the light. After an interval of time the tubes were inoculated with broth cultures of the same anaerobic organism, and incubated at 37° C. The results showed that the medium in those tubes that were not closed by paraffin were altered, whereas the medium in the closed tubes remained active even for over 101 days, so that the air and not the light was the agent for destroying the medium for the culture of anaerobes. Previous drying of the portions of animal or vegetable tissue had no effect as regards the culture of some anaerobic organisms, but with others the growth was not so good, and as in the case of the tetanus bacillus no spores were formed.

The author also obtained cultures of anaerobes when plant seeds, such as barley grains, were substituted for the potato or animal tissue in the culture tubes. The substance that favours the aerobic growth of anaerobes was also demonstrated in wood charcoal, coal and coke, but the growths were not vigorous and spores were not formed. The presence of this substance was also demonstrated in chalk, zinc, and iron. It has long been known that anaerobes can develop in ordinary broth, if an aerobe is simultaneously grown in the same tube, a fact explained by Pasteur as due to the absorption of the oxygen by the aerobe. The author has shown that potato, charcoal, etc., all possess a high degree of reducing power, though with chalk, fresh potato, and zinc this only occurs to a slight degree.

* Lancet, 1907, ii. pp. 1083–4 (1 fig.).
† Centralbl. Bakt., 1te Abt., Orig., xliv. (1907) p. 282. ‡ Tom. cit., p. 607.

Microbe of Whooping Cough.*—J. Bordet and O. Gengou find that the best medium for isolating this organism is a mixture of rabbit's blood and agar containing a little glycerin extract of potato. The frequent presence of Pfeiffer's influenza bacillus is a serious obstacle to the isolation of the whooping cough organism, since it grows more rapidly and freely, and is often difficult to distinguish microscopically, though in culture and in agglutination reactions they are distinct. The authors immunised a horse against this organism and obtained a highly agglutinative serum. The serum of children suffering from or convalescing from whooping cough shows very varying reactions, so that the serum diagnosis of this disease is as yet not practical.

(2) Preparing Objects.

Detecting Fatty Degeneration of the Blood.†—S. G. Shattock and L. S. Dudgeon made films on slips and slides. The films were kept moist from first to last. When made they were at once placed, film-side downward, in a specially devised glass vessel containing formalin, so that they were constantly exposed to the action of the vapour. After an exposure of from 15 minutes to 24 hours or more, the slides were transferred to a solution of Scharlach for 24–48 hours.

The Scharlach solution was made by saturating 75 p.c. alcohol in the cold, and subsequent filtration.

After removal from the Scharlach the slides or slips were washed for a few seconds in 75 p.c. alcohol, then in distilled water, and then immersed in hæmalum for 3 minutes. This was followed by distilled water, tap-water, Farrant's medium. By this method the fat was stained red, but certain granules brown. The latter are called Scharlach-granulations, the exact nature of which the authors leave undetermined.

BERG, W.—**Die Veränderungen des Volumens und Gewichtes des Gewebes bei der histologischen Fixation, dem Auswässern, der Härtung und des Paraffineinbettung.**
[Describes the changes of bulk and weight of tissues during fixation, dehydration, hardening, and paraffin imbedding.]
Anat. Anzeig., xxxi. (1907) pp. 252–68.

MENCL, EM.—**Ueber em neues praktisches Alcoholometer für Präparationszwecke.**
[A pycnometer which is graduated for alcohols of 15-70 p.c.]
Zeitschr. wiss. Mikrosk., xxiii. (1907) pp. 423–4 (1 fig.)

(3) Cutting, including Imbedding and Microtomes.

Imbedding Small Objects in Paraffin.‡—P. Mayer, after referring to G. Lefevre's method of imbedding small objects,§ states that a metal (brass) mould made in two pieces answers better than the watch-glass with an excavation. The illustration (fig. 129) shows Mayer's apparatus of natural size (25 × 25 × 2 mm.). Paraffin blocks made in this mould have quite sharp edges, and are very suitable for sectioning.

* Ann. Inst. Pasteur, xxi. (1907) p. 720.
† Proc. Roy. Soc., Series B, lxxix. (1907) pp. 427–40 (1 fig.).
‡ Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 128–32 (5 figs.).
§ See this Journal, 1903, p. 233.

The author then describes his method for transferring the objects from alcohol to paraffin. For this purpose he uses gelatin capsules (20 mm. long and 7 mm. in diameter). As these capsules are impenetrable to alcohol, this latter must be replaced by benzol or chloroform. The gelatin capsule is easily removed by immersing it in water. As the resulting block is cylindrical, it is made rectangular by immersion in paraffin. For this purpose the brass mould is used.

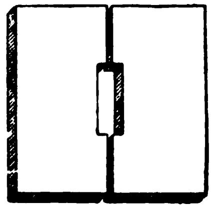

FIG. 129.

Pietsch Microtome.*—E. P. Dolby describes this instrument, which is a modification of the Minot microtome, and claims that it has been simplified and modified. The knife-holder is so constructed that it serves both for paraffin and celloidin sections, and enables the operator to note the angles of inclination most suitable for the work in hand. The active part of the knife may be restricted in order to obtain the greatest rigidity and to use the entire length of the edge before re-sharpening. It is clamped against a three-point plane.

The object-carrier is clamped by only one screw instead of two or three, and also allows a horizontal adjustment of the preparation in order to bring it close to one of the knife clamps.

The coarse-adjustment has been greatly improved and all the gearings reduced, both as to size and number.

The automatic feed is entirely new. It is provided with a worm, and is an inclined plane gliding on another inclined plane, the worm-gear, friction and wear being thereby reduced to a minimum. This feed is the only one which advances when the object is clear of the knife.

Examining the Structure of the House-fly, Musca domestica.†—C. G. Hewitt studied the anatomy by means of dissections of fresh and preserved material under a binocular Microscope, with magnifications varying from 25–65 diameters. Serial sections were made to confirm the dissections and to study the histological details. Perfect series of sections of the whole fly were hard to obtain, on account of the brittle nature of the internal chitinous structures. Colloidin sections were but little superior to paraffin sections. The best results were obtained by fixing the flies for 24 hours in Henning's solution, which is nitric acid 16 parts, chromic acid (0·5 p.c.) 16 parts, corrosive sublimate saturated in 60 p.c. alcohol 24 parts, picric acid saturated in water 12 parts, and absolute alcohol 42 parts, washing out with iodine-alcohol. This fixes and somewhat softens the chitin. The imbedding should not be too protracted, as the chitin becomes brittle again. Serial sections of recently emerged imagines made before the chitin has hardened give good results. Other fixatives used were Perenyi, Rabl's chromoformic, Boum's picroformol, glacial acetic acid, and absolute alcohol. The most satisfactory stains were Heidenhain's iron-hæmatoxylin, Brazilin, and Delafield's hæmatoxylin. By overstaining with the last and differentiating with acid-alcohol perfect results were obtained. The structure

* Trans. Amer. Micr. Soc., xxvii. (1907) pp. 152–3.
† Quart. Journ. Micr. Sci., li. (1907) pp. 399–400.

of the thoracic ganglion was studied by means of reconstruction. The sections were drawn by means of a camera-lucida on Bristol board of a thickness proportional to the magnification. They were afterwards cut out and seccotined together. The resulting model was trimmed and soaked in melted paraffin, taken out and dipped several times till a thin coat of paraffin covered the model. This was then trimmed down to the original size, all the interstices having been filled with paraffin. After a coating of graphite it was electrotyped in copper. In this way a permanent model was obtained.

(4) Staining and Injecting.

Apparatus for Transporting Clean or Prepared Cover-slips.*— A. Hinterberger has found, from practical experience, that cover-slips may be sent by rail or post without danger of damage or contamination by placing them in a glass trough, similar in shape and construction to those used for staining and other purposes. Fig. 130 shows the apparatus and also cross-pieces which enable two slips to be packed in each section.

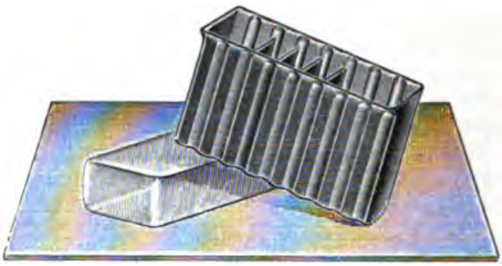

FIG. 130.

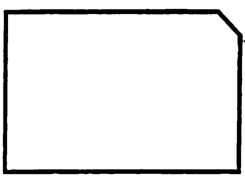

FIG. 131.

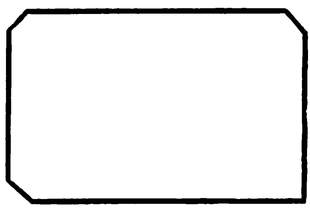

FIG. 132.

The author goes on to mention what he has found to be a time-saving device for examining several cultures simultaneously. Figs. 131 and 132 represent a couple of rectangular cover-slips from which one or three corners have been removed. By making drawings of these on paper, and noting at what corner a film has been deposited, it becomes possible to fix and stain simultaneously on one cover-glass several cultures.

* Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 145–7 (2 figs.).

Method for Accelerating Slow Staining by Electric Current.*—Foix and Mallein, using a Leclanché battery giving 4 volts, have found that, by passing the current through the staining solution during the process of staining, it is possible in 10 minutes to stain *Spirochæta pallida* a violet colour with Giemsa's fluid; the red blood cells being stained, not pink as usual with this stain, but green or pale blue. Similar acceleration was obtained with staining tubercle bacilli by Ziehl's method; the bacilli being thoroughly stained after 10 minutes.

Staining Negri's Corpuscles.†—O. Lentz takes from the cornu ammonis pieces 2–3 mm. thick and places them in aceton for 1 hour at 37°; the pieces are next saturated with paraffin m.p. 55° for 1½ hour at 58° and then imbedded. The sections, stuck on by the water method, are freed from paraffin with xylol and then stained. The solutions required are:—(1) eosin extra B 0·5, 60 p.c. ethyl-alcohol 100; (2) Loeffler's methylen-blue; (3) absolute alcohol 30, 1 p.c. solution of caustic soda in absolute alcohol 5 drops; (4) absolute alcohol 30, 50 p.c. acetic acid 1 drop; (5) Gram's iodine solution.

Two procedures are given:—A. (1) Stain in the eosin solution 1 min; (2) wash in water; (3) stain in methylen-blue solution 1 min.; (4) wash in water; (5) mop up on blotting-paper; (6) differentiate in alkalin-alcohol; (7) differentiate in acid-alcohol; (8) wash in absolute alcohol; (9) xylol-balsam. Films and smears need only be dried after (8).

B. (1) Stain in eosin solution for 1 min.; (2) wash in water; (3) stain in methylen-blue solution 1 min.: (4) wash in water; (5) mordant with the Lugol solution; (6) wash in water; (7) differentiate in methyl-alcohol; (8) wash in water; (9) contrast stain in methylen-blue solution for ½ min.; (10) then proceed as in A from (4) onwards.

Procedure B gives the more definite picture, but in both the bodies are red bestippled with blue spots.

New Method of Flagella Staining.‡—H. C. Plant describes the following method, which is a combination of the Ermengem and Zettnow procedures. (1) The material consists of a loopful of culture in ¼ c.cm. of 2 p.c. formalin solution. (2) The slides to be used are treated with hot strong sulphuric acid, followed by washing, 15 p.c. caustic soda, washing, alcohol, rubbing with fine linen cloth moistened with alcohol-ether mixture āā. (3) Upon the cleaned slide is placed a drop of boiled, filtered, distilled water, and with this is mixed a loopful of the formalin-bacteria mixture. (4) After drying under cover, the film is fixed for 1 hour in a mixture of equal parts of alcohol and ether. (5) It is then mordanted with iodopotassic-iodide solution (1–2 : 300) for 3 minutes; this is followed by alcohol and then water. (6) The film is further mordanted by Ermengem's method: 2 p.c. osmic acid 1 part, 10 p.c. tannin 2 parts (to 100 c.cm. 5 drops acetic acid). The film is left covered with the foregoing solution for 4 hours at room temperature, or for half an hour at 50°; it is then washed with water and alcohol

* C.R. Soc. Biol. Paris, lxii. (1907) p. 1201.
† Centralbl. Bakt., 1te Abt. Orig., xliv. (1907) p. 374–8 (3 photos and 2 pls.).
‡ Tom. cit., pp. 310–16 (1 pl.).

alternately until all trace of the mordant has disappeared. (7) To a saturated solution of silver sulphate and distilled water in equal parts, æthylanin is added until no precipitate occurs. Silver sulphate solution is then dropped on until a precipitate occurs. The film is then covered with this solution and kept moving until a brown colour appears. It is then washed and examined under a low power, and if flagella be not visible, the process should be repeated and this time with the aid of heat. (8) If flagella are visible, then treat with sublimate 1 : 100, until the brown colour has vanished. (9) Follow this with gold chloride 1 to 1000 distilled water, and allow to act for 5 minutes. (10) Next use Zettnow's reducer, 2 p.c. soda solution 4 drops, alcoholic pyrogallic-acid solution (1 : 20) 1 drop ; warm slightly ; dry and mount.

Simple Methods for Staining Liquid Blood.*—R. Ross describes three methods for staining blood.

1. Glass Rod Method : A large drop of blood is taken upon a slide and a drop of stain not larger than the drop of blood is quickly placed close beside it with the end of a glass rod. Then with the other end of the rod the two drops are thoroughly mixed together, and small quantities of the mixture (say of the size of a pin's head) are transplanted on to other slides, and each covered with a slip. Aqueous solutions of many stains may be employed, and will not generally dissolve the red corpuscles if the amount of solution used be not in excess of the amount of blood. One of the most useful stains is an old polychrome filtered saturated aqueous solution of methylen-blue in 0·5 p.c. salt solution.

2. Agar Method : Ordinary nutrient agar is melted and mixed with filtered saturated solutions of various stains (e.g. polychrome methylen-blue) and poured on sloped slides so as to obtain very thin films of the stained agar on the glass. The agar sets at once, but does not dry for some time. While still moist, a coverslip charged with a droplet of blood is placed on it. In a few minutes the elements absorb the stain from the agar. The agar film should be very thin but deeply stained.

3. Drained-drop Method : A cover-slip is charged with a droplet of blood slightly spread out upon it, and is then inverted on a shallow cell made with vaselin on a slide. The coverslip is then pressed down so that the blood-film is in contact with the surfaces of the slip and slide. For staining, the blood may be mixed beforehand with a solution of some stain or perhaps better with a few particles of the undissolved stain.

Ammonio-silver Method for Staining Cancerous Tissue.†—W. F. Robertson and M. C. W. Young communicate the following technique of the ammonio-silver method with gold toning and cyanide decoloration. Place thin slices of tissue in Heidenhain's sublimate solution. After from 12–24 hours, wash the pieces shortly in water and place them in 80 p.c. alcohol (made with absolute alcohol), to which iodin dissolved in absolute alcohol has been added until the fluid has the colour of pale sherry. Renew this fluid daily until it ceases to be decolorised (generally from 4–6 days). Then place the tissues in 80 p.c. alcohol

* Lancet, 1907, ii. pp. 219–20. † Tom. cit., pp. 358–61 (10 figs.).

without iodin. After 24 hours transfer them to 5 p.c. formalin in water. In this they may remain for an indefinite period, but at least one day must elapse before the next stage is proceeded with. Place a piece of tissue in a bowl of water (which should be changed at least once) for from 2–3 hours. Make the ammonio-silver solution by adding 5 p.c. ammonia to 5 p.c. silver nitrate in distilled water, until the precipitate which at first forms is completely dissolved; then add more silver nitrate until a distinct cloudiness returns. Filter this solution into a bottle or specimen tube, add the piece of tissue, and put the bottle, tightly corked, in the incubator at 37° C. for 7 days. The silvering may thereafter be continued in the cold if it is not convenient to go on at once to the next stage. Place a piece of the impregnated tissue in a bowl of water (500 c.cm.) to which about 2 c.cm. of 5 p.c. ammonia have been added. Remove the surface deposit as far as possible. This is best done simply with the aid of the fingers whilst the piece of tissue is held under water. Transfer the piece to a second bowl of ammonia and water. Renew the fluid after about an hour, and leave the tissue in this for 3–4 hours longer. Transfer to dextrin solution (dextrin 5 oz. or 140 grm., water 10 oz. or 280 c.cm.; dissolve by boiling; filter the solution through cotton-wool while still hot; after it has cooled add 1 p.c. of carbolic acid) to which ammonia has been added in the proportion of 10 drops of a 5 p.c. solution to 1 oz., immediately before use. Allow the tissue to remain in this from 12–24 hours. Cut thin sections on the freezing microtome. Transfer them from the knife to a bowl of water to which about 10 drops of 5 p.c. ammonia have been added. After about 5 minutes transfer the sections to another bowl of ammonia and water, and after a similar period give them a third wash. Transfer the sections to a bowl of water to which have been added from 5–10 drops of a saturated solution of citric acid in water, and allow them to remain in this for 4–5 minutes. Place the sections in a bowl of tap water, and after a few minutes transfer them to a second bowl of water. They are now ready for toning.

The reagents required for the toning and decoloration processes are 1 p.c. solution of gold chloride in distilled water, 1 p.c. solution of pure sodium tungstate in distilled water (it is necessary to effect the solution of the salt by boiling), and 1 p.c. potassium cyanide in distilled water. Using only a clean glass rod or platinum needle, place from six to twelve sections in a watch-glass containing a mixture (carefully filtered) of the sodium tungstate and gold chloride solution in equal portions. Allow the sections to tone for about half an hour, or until they assume a distinct red tint, and then transfer them to a bowl of water in which they should be allowed to wash for some minutes. Next place the sections one at a time in a watch-glass containing a little of the cyanide solution. When the section has lost its deep red colour and assumed a light pink tint, transfer it to a bowl of water and allow it to wash for from 10–15 minutes, giving at least one change of water. Next stain the section for from 5–10 seconds in Loeffler's or Neisser's methylen-blue, wash it well in water, dehydrate with absolute alcohol, clear in equal parts of turpentine and benzol, and mount in benzol-balsam.

Fixing of Stains by Bacteria.*—G. Péju and H. Rajat experimenting on the staining properties of various bacteria during life with a number of different staining reagents, find that these latter may be considered in three groups. Firstly, those stains that colour the medium, often intensely, but leave the colour of the culture unaffected, and which includes carmin, fuchsin, hematein, hematoxylin, blue-azur, malachite-green, etc. Secondly, those stains that colour the medium and culture alike, and includes eosin, methylen-blue, neutral-red, Merck-red, picric acid, heliantin, etc. Thirdly, those stains that are taken up by the bacteria, the medium being decolorised.

RÖTHIG, P.—**Wechselbeziehung zwischen metachromischer Kern- und Protoplasmafärbung der Ganglienzelle und dem Wassergehalt alcoholischen Hämotoxylin Lösungen. Parts 2 and 3.** (For Part 1 see this Journal, 1907, p. 110.)
Zeitschr. wiss. Mikrosk., xxiv. (1907) pp. 109–28.

(6) Miscellaneous.

Detection of Bilharzia Ova in Urine and Fæces.†—T. Mazzei finds that the following procedure gives better results than the methods usually adopted. The sediment of the urine or of the diluted fæces is spread out on slides, and the thickish and extensive layer dried at a gentle heat until all the water is evaporated. The preparation is then washed for 5–10 minutes in an aqueous 3 p.c. solution of hydrochloric acid, and examined under a low power to see if all the salts have been dissolved out. They are then washed for 5–10 minutes in a 30 p.c. solution of caustic soda or potash, in order to get rid of the mucus and other organic elements. The films are then dried with gentle heat and after this may be examined under the Microscope to ascertain if any parasites are present. It is sometimes better to stain the preparation with borax methylen-blue, and afterwards differentiate with 1 p.c. hydrochloric acid. Instead of methylen other pigments may be used, such as carbol-thionin or Ehrlich's hæmatoxylin.

Microscopic Study of Pen and Ink Lines.‡—M. D. Ewell finds that the serrations in ink and pencil lines are due to irregularities in the surface of the paper itself. By making very thin films on glass with carbon from a smoky flame, or with a solution of wax and asphaltum in benzol, and writing thereon with the dry steel pen, it was found, on examination under a power of over 120 diameters, that the lines were clear, sharp, and free from serrations of any sort. The ordinary writing of the same persons on paper with pen and ink had previously shown abundant serrations. Other explanations of the phenomenon are that the inequalities are due to variations of nerve force or to pulsations from the vascular system.

Errera's Practical Course of Vegetable Micro-chemistry.§—By micro-chemistry the writer of this little treatise means the localisation of substances in plants, "microscopical topo-chemistry." The booklet consists of the notes used by Léo Errera in the practical course of

* C.R. Soc. Biol. Paris, lxii. (1907) p. 954.
† Riforma Medica Ann., xxi. No. 24.
‡ Trans. Amer. Micr. Soc., xxvii. (1907) pp. 21–3.
§ Bruges, 1906, 24 pp.

vegetable micro-chemistry, which was given to the students who desired to present themselves for the Doctorat en Sciences at the University of Brussels.

Prowazek's Manual of Microscopical Technique.*—S. v. Prowazek's little manual for the microscopical technique of Protozoa, is principally intended for medical men, though it also appeals to zoologists. It deals with the mode of examination in living and fixed preparations of Rhizopoda, Mastigophora, Sporozoa, and Ciliophora.

WOITHE—**Vorrichtungen zum gefahrlosen Befestigen und aufspannen wilder Ratten.** [Description of apparatus for fastening and extending rats for laboratory purposes.] *Centralbl. Bakt. Orig.*, 1te Abt., xliv. (1907) pp 709–19 (11 figs.).

Metallography, etc.

Alloys of Aluminium and Copper.†—H. C. H. Carpenter and C. A. Edwards have carried out an extended investigation of this series. Forty-eight alloys were examined. The work consisted chiefly of determination of the mechanical properties of the industrially useful alloys—i.e. those lying outside the range 11–96 p.c. aluminium. The equilibrium diagram was also worked out, and the microstructure of the alloys studied. Alloys with 0–8 p.c. Al have a low yield point, moderate ultimate stress and high ductility, and are not sensitive to heat treatment. From 8–11 p.c. Al the ultimate stress is high, yield point relatively low, ductility good from 8–10 p.c. Al. Alloys in this class are hardened by chilling from above 800° C., and considerably affected by other forms of heat treatment. The increase of hardness occurring at about 8 p.c. Al coincides with the appearance of a dark, acicular constituent. Alternating stress tests in the Stanton machine showed that the ratio

$$\frac{\text{maximum range of stress}}{\text{primitive yield point (in tension)}}$$

increased from 1·3 in the alloy with 0·1 p.c. Al to the remarkably high figure of 1·9 in the 9·9 p.c. alloy. The addition of copper to aluminium progressively raises the tenacity up to 4 p.c. copper, ductility correspondingly falling. The authors consider that the great evolution of heat resulting from the addition of aluminium to molten copper, is due to oxidation of the aluminium by copper oxide dissolved in the copper. It is suggested that the growth of size of crystal observed on remelting certain alloys is due to the persistence of crystalline orientation in the molten state—i.e. to the occurrence of "liquid crystals." The etching reagents used were sodium hydrate solution for aluminium and the aluminium-rich alloys, ferric chloride in dilute hydrochloric acid for the copper-rich alloys, and for copper, concentrated nitric acid followed by washing in a heavy stream of water on the commencement of chemical action. A comparison is drawn between the equilibrium diagram and

* Leipzig: J. A. Barth, 1907, 66 pp.
† Proc. Inst. Mech. Engineers, 1907, i. pp. 57–378 (204 figs). (Eighth Report to the Alloys Research Committee.)

that of the copper-tin series. The compounds found are Cu_4Al, Cu_3Al, and $CuAl_2$. In the discussion W. Rosenhain gave results showing the fall in tenacity of certain of the copper-rich alloys with rising temperature. G. H. Gulliver severely criticised the equilibrium diagram and submitted an amended diagram. The authors claimed that Gulliver's objections were due to misunderstanding of their results.

Constitution of the Aluminium Bronzes.*—B. E. Curry has determined the equilibrium diagram above 400° C., obtaining thermal data entirely from heating curves, thus eliminating super-cooling effects. The thirty-four alloys prepared were also examined microscopically, after annealing of sufficient duration to produce equilibrium. The diagram given differs in important respects from that given by Carpenter and Edwards. Only one compound, $CuAl_2$, was found, with six series of solid solutions. Two thermal changes occur below the solidus.

Tensile Strengths of the Copper-Aluminium Alloys.†—B. E. Curry and S. H. Woods have investigated the relation between constitution and mechanical properties, and give a series of tables of results of tensile tests of alloys in the ranges of composition 0–25 p.c. and 86–100 p.c. copper. The test pieces were cast to size in Acheson graphite moulds. The alloys were tested as cast, and after annealing and quenching at various temperatures. Two successive additions of aluminium to molten copper each caused a rise of temperature, showing that the heat evolution is due to heat of solution, and not to oxidation of the aluminium by oxygen dissolved in the copper. The author concludes that (*a*) in the aluminium-rich series (1) the maximum dependable strength occurs in the neighbourhood of the 10 p.c. copper alloy; (2) annealing at 400° C. for 3–6 days reduces tensile strength, and increases ductility; (*b*) in the copper-rich alloys (1) with more than 92 p.c. copper, annealing has little effect; (2) with 89–91 p.c. copper the mechanical properties are considerably affected by heat treatment; (3) alloys with less than 90 p.c. copper are brittle and unreliable.

Methods of Testing.‡—This paper contains a description of the methods elaborated by the International Committees appointed by the Association, with the unification of testing methods as its aim. The length (l) of a tensile test-piece is calculated according to the formula $l = n\sqrt{f}$, f being the area of cross-section, and n a coefficient, for which the value 11·3 has been adopted in many countries. Elastic limit may be considered to lie at the point where the permanent deformation is about 0·001 p.c. Limit of proportionality is to be regarded as the stress up to which equal increments of about 100 kilos. per sq. cm. produce equal elongation. The apparent elastic limit is to be taken as the stress which causes a permanent elongation of between 0·2 and 0·5 p.c.

* Journ. Phys. Chem., xi. (1907) pp. 425–36 (2 figs.).
† Tom. cit., pp. 461–91 (7 figs.).
‡ Methods of testing metals and alloys; hydraulic cements and woods; clay, stoneware and cement pipes. Recommended by the 4th (Brussels) Congress of the International Association for Testing Materials, 1906. London: E. & F. N. Spon, 54 pp. (5 figs.).

Some Phenomena of Permanent Deformation in Metals.*—G. H. Gulliver corrects his earlier hypothesis that the "contractile cross" is the result of the slipping of crystalline grains over each other. By subjecting thin strips of aluminium—rendered coarsely crystalline by heating nearly to melting point—to tension, and watching the progress of deformation by the Microscope, the author has found that (1) the phenomena of constriction and fracture are due to excessive local "slipband" deformation; (2) the contractile cross passes through the crystalline grains; it is somewhat influenced by the degree of coarseness of the crystalline structure, but is independent of the directions of the boundaries of the crystalline grains.

Passage from the Liquid to the Solid State.†—Three papers‡ by G. Cartaud are here reprinted, together with a series of remarkable photomicrographs and a necessarily incomplete account by F. Osmond of the further researches of Cartaud interrupted by his death. Indications of a cellular, as distinct from a crystalline structure, are obtained when lead, tin, zinc, and other metals are cast on a sloping sheet of glass. In this manner a thin and rapidly solidified layer of the metal is formed. There appears to be some relation between the cellular network and the crystalline structure. Cartaud applied the term "metalloblast" to the primitive cellule, "crystalloblast" to the incipient crystal. It is suggested that metals, during solidification, pass through the cellular state before becoming truly crystalline. Osmond considers this subject to be a fruitful field for research.

Hardness of Tool Steels.§—Demozay gives the results of determinations of hardness by the Brinell method of tool steels, some being high-speed steels containing chromium and tungsten, hardened at different temperatures in air, oil, or water. Similar measurements were made at 100° C., 250° C., 400° C., and 500° C., on the steels after different previous treatments. For the high-speed steels the hardness rises to a maximum at 200–250° C., slowly decreasing as the temperature is further raised. For certain steels the temperature of maximum hardness is higher as the quenching temperature is higher.

Phenomena of Solidification and of Transformation in Alloys.‖—A. Portevin works out afresh the application of the phase rule to the equilibrium of a two-component system. The departure from stable equilibrium, produced by insufficiently slow cooling, and resulting in a condition of labile equilibrium, which occurs so frequently in alloys having transformation points in the solid state, is fully considered.

Specific Heat of Iron.¶—P. Oberhoffer has made very careful determinations of the mean specific heat of iron between 0° C. and temperatures from 265–1523° C. A full account is first given of previous work. Objections which can be urged against the methods of

* Proc. Inst. Mech. Engineers, 1907, ii. pp. 519–24 (9 figs.).
† Rev. de Métallurgie, iv. (1907) pp. 819–32 (72 figs.).
‡ Comptes Rendus, 1901, 1903, and 1904.
§ Rev. de Métallurgie, iv. (1907) pp. 885-900 (11 figs.).
‖ Tom. cit., pp. 915–25 (5 figs.).
¶ Metallurgie, iv. (1907) pp. 427-43, 447-55 and 486-97 (22 figs.).

Pionchon, Harker, and others, are stated. Preliminary experiments with the water calorimeter and the Bunsen ice calorimeter led to the selection of the latter for the author's determinations. The sample (iron containing 0·06 p.c. carbon and 0·05 p.c. manganese) was heated in vacuo by means of a resistance furnace. For very high temperatures the furnace resistance was a carbon spiral cut from a tube. A detailed description of the apparatus evolved by the author is given. The following values (mean specific heat between the given temperature and 0° C.), selected from the author's table, show the course of the curve. The rapid rise from 650–750° C. is notable.

250° C. 0·1221
650° C. 0·1463
750° C. 0·1675
800–900° C. (practically constant) 0·1698
1100–1500° C. „ „ 0·1661–0·1667

The course of the curve in the neighbourhood of Ar 2 renders it highly probable that the transformation of β to α iron proceeds through a continuous series of mixed crystals, as suggested by Osmond. The specific heat of γ iron is practically constant. A useful bibliography is appended.

Capacity of Metals to Form Compounds with each other.*—G. Tammann gives a table showing the well established metallic compounds (about 100), and attempts to draw some general conclusions.

Braune, H.—**Nitrogen Absorption in Cementation.** *Stahl und Eisen*, xxvii. (1907) pp. 1395–8.

„ **Micrographic Investigation of Iron and Steel.** *Eisen-Zeitung*, 1907, pp. 223–4, 243–5, 259–60, 276–7.

Coehn, A., & C. L. Jacobsen—**Electrochemical Behaviour of Gold and its Passivity.** *Zeitschr. Anorg. Chem.*, lv. (1907) pp. 321–55 (11 figs.).

Ducelliez, F.—**Cobalt-tin Alloys.** *Comptes Rendus*, cxlv. (1907) pp. 431–3 and 502–4.

Philips, M.—**Silicon-copper.** *Metallurgie*, iv. (1907) pp. 587–92 and 613–17.

Pouchine—**Electromotive Force of Alloys.** *Rev. de Métallurgie*, iv. (1907) pp. 926–35 (22 figs.).
[Wologdine gives a lengthy abstract of the paper summarised in this Journal, 1907, p. 642.]

Vigouroux, E.—**Nickel-tin Alloys.** *Comptes Rendus*, cxlv. (1907) pp. 429–31.

Walker, W. H., & L. N. Bent—**Corrosion of Iron and Steel.** *Journ. Amer. Chem. Soc.*, xxix. (1907) pp. 1251–64.

Influence of Chemical Composition and Structure on the Rusting of Iron and Steel. *Stahl und Eisen*, xxvii. (1907) p. 925.

* Zeitschr. Anorg. Chem., lv. (1907) pp. 289–96.

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 16TH OF OCTOBER, 1907, AT 20 HANOVER SQUARE, W.
DR. J. H. W. EYRE, VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of the 19th of June, 1907, were read and confirmed, and were signed by the Chairman.

The List of Donations to the Society (exclusive of exchanges and reprints) received since the last Meeting, was read.

	From
Adams, Geo., Essays on the Microscope, 2nd ed. (4to, London, 1798)	*Committee of the Sunday School Union.*
,, Plates to the above. (1787, 1797)	*Mr. F. A. Parsons.*
Spitta, E. J., Microscopy. (8vo, London, 1907)	*The Author.*
Clarke, Saml. F., The Hydroids, being No. 8 of Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific by the U.S. Fish Commission Steamer 'Albatross,' Oct. 1904 to March 1905. (8vo, Cambridge, Mass., U.S.A.)	*The Author.*
Hanausek, F. F., The Microscopy of Technical Products, Trans. by Andrew L. Winton, Ph.D. (8vo, New York and London, 1907)	*The Publishers.*
White, T. C., The Microscope, and How to Use it, 3rd ed. (8vo, London, 1907)	*The Publisher.*
A Warington's Universal Microscope	*Mr. J. E. Ingpen.*

Attention was specially called to several of these by the Secretary, as follows: A copy of "Adams on the Microscope," second edition 1798, presented by the Committee of the Sunday School Union, and rendered complete by the presentation of the volume of plates, contributed by Mr. F. A. Parsons. Two works on Microscopy had also been presented by gentlemen who in one case had been and in the other was at the present time, a Fellow of the Society and President of the Quekett Club, the former being by Mr. W. Charters White and the latter by Mr. E. J. Spitta. Mr. Spitta's work was of a very complete character, so that it was certain to be a valuable book of reference and instruction.

A further donation to the Society was one of Warington's Universal Microscopes, presented by Mr. J. E. Ingpen.

Mr. Rousselet said this was a very ingeniously constructed portable form of Microscope, capable of being used in an upright, slanting, or horizontal position, and was interesting as having once belonged to Dr. W. B. Carpenter, who frequently made use of it and was fond of working with it. Mr. Ingpen acquired it at the sale of Dr. Carpenter's instruments, and the Society was very glad to possess it.

On the motion of the Chairman a very hearty vote of thanks was passed to the donors of these presents.

The Chairman said they had before them a very interesting exhibit prepared by Dr. Hebb, who under a large number of Microscopes showed a series of preparations representing a day's work in the Clinical Laboratory of a London General Hospital. The variety of subjects was very great, including blood specimens, bacteriological specimens, and histological specimens of the products of numerous diseases, and he thought their thanks were specially due to Dr. Hebb for the trouble he had taken in getting together such an interesting collection.

Mr. Beck hoped that Dr. Hebb would say a few words with reference to his exhibit, which he was sure would add greatly to its interest.

Dr. Hebb said that he had called his exhibits a sample of a day's work in a clinical laboratory. Though the specimens exhibited had been made at different times, it would be quite possible that all of them might have been sent up and examined in a single day. He said this to indicate some of the work that goes on daily; this, however, was far from representing the sum total of laboratory work, for it did not include the still more numerous chemical and physico-chemical examinations. He was afraid that this evening's show was not sufficiently interesting to the lay Fellows, and certainly it was far below what the Society was accustomed to, and did not attempt to rival the beautiful exhibitions given by Messrs. Hilton, Earland, Rousselet, and many others. The assembly had been good enough to applaud his endeavour, and he hoped that they would include in their thanks his assistant, Mr. Chopping, who was present, and had spent much time in arranging the preparations.

Mr. H. Taverner exhibited a number of Stereo-Photomicrographs, such as he had described on a former occasion as being taken with a stop placed behind the objective (this Journal, 1906, pp. 260–2). Those now shown were water mites in natural colours, and were taken by the Sanger-Shepherd three-colour process illuminated with a Nernst lamp.

Mr. Rousselet exhibited a pair of cutting forceps made by Mr. Curties, and also a pair of forceps-scissors made by Mr. Traviss, which he thought would supply a long-felt want. Everyone who studied pond life must frequently have had occasion to cut off under water a small piece of weed upon which some particular organism was attached, the result usually being that the piece when cut fell to the bottom of the tank, where it was always difficult to pick up and sometimes impossible to find, so that something was wanted which would not only cut, but would hold it fast when cut. He had mentioned this want years ago to various persons, but no one seemed to have taken it up, and it was only within the last week that he had received from Mr. Curties this pair of cutting forceps designed for the purpose, and also from Mr. Traviss the pair of scissors which did the same thing in a very simple and ingenious way. Both these contrivances answered the purpose exceedingly well, and the smallest particle of weed cut off was securely held until purposely released. Forceps and scissors should have long stems, 6–6½ in. total length, in order to be able to reach the bottom of a micro-tank.

Mr. W. R. Traviss, in further reference to the subject, showed by drawings on the board how the blades of these scissors were modified to answer the purpose required, enabling them to hold the piece of weed quite firmly first, and to cut it afterwards.

The Chairman thought this little instrument was likely to be extremely useful to the many microscopists interested in pond life, and proposed the thanks of the Society to those gentlemen who had brought it under notice.

Mr. A. A. C. E. Merlin's paper "On Ghost Images seen in the secondaries of *Coscinodiscus Asteromphalus*," was read by Dr. Hebb.

The Chairman said it was a matter of regret that the author of this paper was not able to be present to read the paper himself. The subject-matter was extremely interesting, and he should be glad to hear any remarks upon the opinions expressed in the communication.

Mr. Beck said there was one point which might be inferred from the paper which was probably not intended to be conveyed by Mr. Merlin, and that was as to the advantage of the use of very high eye-pieces under ordinary circumstances. No one should think of using a 1-inch objective with a high eye-piece in order to make it do the work of a $\frac{1}{4}$-inch, it being well known that high eye-pieces could only be usefully employed with high-angled objectives, and the advantage of high eye-pieces only commenced when used with lenses of high power and maximum aperture. He thought that in dealing with such subjects too much stress was often placed on resolution, which only applied to objects which possessed a regular structure; there was much yet to be learned as to the limits of visibility of objects with irregular structure. Several papers had been read before the Society showing that whilst a single line could be easily seen, it was a much more difficult matter to resolve a number of such lines when close together. In drawing attention to the advantage of high magnifying powers in the cases mentioned Mr. Merlin had done a useful service. His experiments with low power objectives were valuable by way of illustration, but could scarcely be recommended in themselves for practical observations.

Mr. J. W. Gordon said that there was another advantage of high magnifying power of which he did not remember having seen any notice in Mr. Merlin's paper or elsewhere. It was due to the circumstance that every lens produced not a simple plane image, but a solid image of the structure on the stage. In the case of objects like diatoms, where they had various structures lying close together one beneath another, it was of importance to be able to separate these in the eye. By means of a drawing on the board, Mr. Gordon showed that if the object under view was a cube, a solid image of this would be formed in the eye having a certain depth along the optical axis proportionate to the magnification. The position of this solid image in relation to the plane of the retina could be altered if it was wished to see what lay in any particular plane. If they had two sets of markings on the cube, one on the top and the other on the bottom, they must have them sufficiently far apart for one set to lie clear of the sensitive region of the eye if they wished to see the other set distinctly, and to get the top and

bottom separated by a considerable distance was what resulted from increase of magnifying power. This was, therefore, quite apart from any increased resolving power in plan, a very important matter when it was a question of showing a particular plane in any composite object.

A further paper by Mr. Merlin, entitled "A Note on a New Prismatic Ocular," was also read by Dr. Hebb, the diagram in illustration having been previously drawn on the board.

Mr. Beck said the novelty about this contrivance appeared to be the curved surfaces. Chevalier, of Paris, had made one of the same kind with flat surfaces, and it had since been made with what is called a roof prism, which gave a perfect erection, both right and left and up and down. Such a prism is only serviceable when the Ramsden circle is situated at a considerable distance from the upper surface of the eye-piece.

A note by Mr. E. M. Nelson "On a New $\frac{1}{6}$ inch Semi-apochromatic Objective of 0·74 aperture, computed by Mr. Conrady," was read by the Secretary.

Mr. Spitta said that he had had the privilege of seeing the objective in its workshop mount, and that he could corroborate all Mr. Nelson said. As, however, he noticed this gentleman had not mentioned any use of the Abbe plate, he rose to say that the performance of the combination in question with this—the severest of all tests—was very satisfactory; indeed, the correction of the outer zone, which was always the weakest in most sixths, was distinctly an advance. Of course the aperture of this new sixth was not so large as that of the holoscopic series having the same focal length, but notwithstanding this, it resolved the dots in *Nitzschia scalaris* with direct light exceedingly well, far better, he was bound in common justice to say, than some, although he did not wish to say all, other examples of the optician's craft (of similar focal length) which had come before his notice. The long working distance was, perhaps, the leading feature of the new objective; he had never known one so great, and, as Mr. Nelson had found, it amounted to at least a millimetre in length, which might be called positively phenomenal. He should like to be permitted to congratulate both the computer and the manufacturer.

The Chairman said it was a matter of considerable importance to have a lens with a long working distance, because, when examining a hanging-drop preparation, it was most desirable to be able to focus from the top to the bottom of the drop. A lens of this kind was quite an acquisition to working bacteriologists.

A Paper by Mr. Alfred Letheby "On Systematic Exposure with Transmitted Light in Photomicrography" was taken as read.

The Secretary said they had received from Mr. F. H. Baker and Mr. J. D. Macphail some material, consisting of Diatomaceous earth and Radiolaria, for distribution to any Fellows wishing to have any. Application for samples of these should be made to Mr. Parsons.

On the motion of the Chairman, the special thanks of the Society were voted to Dr. Hebb for his exhibits and to Messrs. Beck for the loan of a number of Microscopes under which these were shown.

New Fellows.—The following were balloted for and duly elected Ordinary Fellows of the Society: Messrs. John W. Eastham and Frank Thatcher.

The following Instruments, Objects, etc., were exhibited:—

The Society:—A Warington Universal Microscope.

Dr. R. G. Hebb:—The following slides: Rickets; *Deciduoma malignum* vel. *Chorion-Epithelioma*; Uterine mucosa at menstrual period; Sarcoma affecting spinal meninges; Colloid cancer; Paget's disease of nipple; "Cancer bodies"; Epithelioma of lip; Ringworm; *Bilharzia* ova in skin; *Molluscum contagiosum*; *Pityriasis versicolor*; *Madura* foot; Trypanosomes; Malarial parasites, Crescents; Malarial parasites, Ring-form; Pernicious Anæmia; Splenic Leukhæmia; Spleno-medullary Leukhæmia; Phagocytosis.

Mr. C. F. Rousselet:—A Pair of Cutting Forceps and a Pair of Forceps Scissors for cutting off and holding pieces from weed contained in Micro-aquaria.

Mr. Taverner:—Stereo-photomicrographs of Water Mites, taken by the Sanger-Shepherd three-colour process.

MEETING

Held on the 20th of November, 1907, at 20 Hanover Square, W., The Right Hon. Lord Avebury, F.R.S., etc., President, in the Chair.

The Minutes of the Meeting of the 16th of October, 1907, were read and confirmed, and were signed by the President.

The List of Donations to the Society since the last Meeting (exclusive of exchanges and reprints) was read, and the thanks of the Society were voted to the donors:

	From
Mauritz von Rohr, Die binokularen Instrumente. (8vo, Berlin 1907)	*Messrs. Carl Zeiss.*
Ubler, H. S., & R. W. Wood, Atlas of Absorption Spectra. Carnegie Institution of Washington, Publication No. 71. (4to, Washington, 1907)	*Prof. R. W. Wood.*

Mr. Beck exhibited under Microscopes in the room two photographic plates prepared for the Lumière starch-grain process—one of which had been exposed and the other had not. These showed the stained starch-grains clearly, and also the silver underneath. The starch-grains were only about $\frac{1}{2000}$ inch in diameter, and therefore too small to be seen

with the naked eye. If the object-glass of the Microscope showing the unexposed plate be racked out of focus, so that the colours are blended, a very close approximation to white light is obtained. If it be placed only partially out of focus, patches and channels of colour are visible—due to the fact that the coloured grains are not sufficiently closely intermingled. These patches of colour are what are seen in examining autochrome plates, the individual grains being much too fine to be visible without very high magnification.

Mr. C. Lees Curties (C. Baker) described two inexpensive Microscopes made by his firm. The first, known as the "Nature Study" Microscope, mounted on a heavy square foot and upright both in one casting, has diagonal rack-and-pinion adjustment, and sliding movement to body-tube. To allow large objects to be examined, the large stage (4 by $3\frac{3}{4}$ in.) and mirror can be removed and the specimen placed on the square flat base of foot. A dividing combination objective of 2, 1, and $\frac{1}{2}$-in. powers, and one eye-piece, 23·3 mm. gauge, are supplied, but the instrument is suitable for any objective up to $\frac{1}{6}$ in.

The other instrument, the "Meat Examiner's" Microscope, is made on the same lines, but has a stage having grooves in the vertical direction; a compressor, with points to slide in these grooves, accompanies the Microscope, and by sliding this in first one groove and then the next, the entire surface of specimen in the compressor can be examined without going over the same ground two or three times, as is usually the case when a plain stage is used. The distance of each groove apart equals the size of field of view when a 1-in. objective is employed.

Mr. J. I. Pigg exhibited a number of lantern slides—photomicrographs from nature—showing the various stages in the growth and development of fern spores, from the earliest sign of germination to the mature frond, with its fructification.

Mr. Moffatt exhibited and described a new form of filter for use with agar and other media which melted at a comparatively high temperature. Used in conjunction with an exhaust pump, large quantities can be filtered quickly, giving a very clear filtrate.

Mr. E. M. Nelson's description of the "François Watkins' Microscope" was read by Dr. Hebb. The Microscope itself, made entirely of silver, was exhibited in the room, together with two from the Society's collection by way of comparison. In further illustration of the subject, some lantern slides were shown upon the screen, representing the Microscope in the different positions in which it was intended to be used.

Mr. J. W. Gordon said that his paper, "On Mercury Globules as Test Objects for the Microscope," was already in print, and had been placed in the hands of Fellows of the Society who were interested in the subject. He therefore thought it might be taken as read. But for the benefit of those who had not seen it he gave a résumé of

its general purport, illustrating his remarks by drawings upon the board and by reference to the examples shown under Microscopes in the room, for the use of which he was indebted to Messrs. Beck. He also read an extract from a letter received from Dr. G. Johnstone Stoney, in which the writer remarked that the strong reflection from the lens surfaces of the objective, to which attention was drawn in the paper, was very conspicuous and troublesome in the use of a vertical illuminator, as the reflection in that case was given off by the upper surfaces of the lenses and received directly by the eye of the observer. Dr. Stoney also expressed the opinion that the coloration of *Pleurosigma angulatum* was capable of another explanation than that put forward in the paper.

Mr. Gordon, in view of Dr. Stoney's criticism of his reference to *P. angulatum*, showed upon the screen two photographs of *P. formosum*, one of which was taken with a narrow-angle objective, and the other under one with a high angle; in the one case it was shown as having black dots, and in the other these appeared white. He mentioned also that when this diatom was illuminated by light from a light source of annular form, the source of light being focused in the plane of the stage, its dark centre was visible through the specimen as a patch in the field of the instrument when the condenser beam was cut down to a narrow angle, but that if the angle were opened up so as to yield strong reflection from the objective, the dark patch disappeared, but the bright dots overlying the dark patch still retained minute black centres, evidently due to small foramina in the silex, through which the dark background could be seen even when the upper surface of the silex was so refulgent that the dark patch could not be seen through its substance. He submitted this as being an undeniable instance of the striking effect of the top light from the objective in modifying the appearance of a diatom.

Mr. Conrady said that the usual explanation of the brown appearance of *P. angulatum* under low powers was derived from the fact, easily ascertained by looking down the tube, that this diatom transmitted light of a distinctly brown colour, whilst the light diffracted by it showed a decided preponderance of blue. Low-power objectives transmitted only the brown direct light, and therefore showed the diatom of a uniform brown colour. As soon as the diffraction-spectra began to enter, their preponderating blue light compensated the brown of the direct light, and produced an approach to whiteness in proportion to the quantity of diffracted light admitted. The explanation of the white dot by light reflected back by the objective, did not appeal to him; it was well known that all these dotted structures had a double focus, known as the white dot and the black dot respectively, and he had indeed noticed that the photograph shown by Mr. Gordon in this connection, whilst showing white dots in the upper half, showed the black dot, somewhat out of focus, on the other side of the central rib. As both halves of the diatoms were necessarily under the same conditions as to illumination, Mr. Gordon's explanation was obviously wrong. Mr. Gordon's suggestion of using the tiny black dot obtained by double reflection as a test of resolving power, was futile. The seeing of a single object, whether dark or bright, was a question of

contrast, and had nothing to do with resolving power. If they were to look up Lord Rayleigh's paper on the subject, which Mr. Gordon claimed as his authority for his views, they would find that Lord Rayleigh unreservedly adhered to the accepted limits of resolving power established by Helmholtz and Abbe, and was therefore entirely at variance with the interpretation put upon his paper by Mr. Gordon.

Professor Porter said he had very little to say as to the paper, except perhaps to emphasize Mr. Conrady's remarks, especially as to the possibility of a single globule being utilisable as a test object.

Mr. Beck said that he had been recently examining living bacilli with high powers by means of a modification of the Siedentopf apparatus; it was extremely interesting to notice the great difference there was in some of the bacilli and minute organisms according to their reflecting character, some of which were probably micrococci, showed as extremely brilliant luminous spots surrounded by a brilliant series of diffraction rings, which were so large in diameter and so numerous that they could scarcely be caused by the diffraction of the Microscope object-glass, and might probably be due to a reflection from a spherical surface in a similar manner to those shown by Mr. Gordon as reflected from a mercury globule. Other forms of bacteria showed no diffraction, and the reflected light would appear to come from the marginal envelope of the bacillus.

Mr. Gordon said the only point left for him to deal with seemed to be as to whether a single object could be a test of resolving power. What Mr. Conrady and Professor Porter had said on this point would be perfectly true in the case of a single bright object, but a single dark object was for this purpose entirely unlike a bright object. A dark object is itself invisible although it might in a sense be said to be seen when in a bright field by contrast with the field in which it lay. Thus, for example, a telegraph wire projected against a bright sky could not itself be seen. An observer could not tell whether it was bright or rusty or painted, but he might be able to see that the sky itself was divided into two bright fields by a thin dark line. This is what people meant by saying that they could see a telegraph wire in the sky, and thus the visibility of the wire afforded evidence that the image of the sky was divided up into two perfectly resolved parts. Thus, although a single bright object affords no test of resolving power, a single dark object seen by contrast with a bright field in which it lies is not only a possible test, it is the only possible test and measure of the resolving power of any optical instrument.

Mr. E. M. Nelson's paper in reply to Professor Porter's and Mr. Everitt's criticism of his paper "On the Limits of Resolving Power in the Telescope and Microscope" was read by the Secretary. Professor Porter said he had seen Mr. Nelson's paper and had written a reply, which he proceeded to read, illustrating his remarks by diagrams drawn upon the board, showing that the origin of the dispute appeared to be that Mr. Nelson failed to realise that two objects might be so close together that the central disks of their images considerably overlapped, yet there would be so much less light in the middle that they would appear as two. The usual conventional limit of resolving power corresponded with the case where the first dark ring of one coincided with the central maximum of

the other, but this was not really the ultimate limit, which was still closer. What he and Mr. Everitt had questioned was that Mr. Nelson had given the measurement of the first diffraction ring, as he seemed to claim to do. They did not deny that Mr. Nelson had gone considerably beyond the conventional limit, and theory showed that a closer approach than the conventional limit was possible. Professor Porter suggested that it might be better to take as the true limit the closeness for which the midpoint of the double image just failed to show a diminution in intensity.

Mr. J. W. Gordon said the question was one of extraordinary interest, and he hoped at some future time to have the opportunity of making a contribution to the discussion of the subject which at that late hour of the evening would not be convenient. He would only suggest a doubt as to whether the calculations to which Professor Porter had referred applied at all in the empirical focal plane, as he thought it quite possible that the empirical focal plane lay below the theoretical focal plane for aplanatic rays. He should like to elaborate that suggestion. Another observation which he would like to make was that what Professor Porter had been talking about was the image formed by a luminous point, such as occurs only in practice when a star is observed. These antipoint curves do not apply in the case of a small area such as constitutes the minute detail seen in a Microscope. In discussing those, we need to take into account not only the bright diffraction fringe which lies upon the dark field, but also the dark diffraction fringe which borders the bright field, and which has an equally important bearing upon the problem of resolving power.

The President, in moving a vote of thanks to Mr. Nelson and those who had taken part in the discussion, hoped that Mr. Gordon would on some future occasion exhibit some more of his beautiful photographs, and also that he would give them the benefit of his views of the subject.

Mr. Moffatt read a paper " On Light Filters for Photo-micrography," exhibiting in illustration of the results obtained some very fine prints of *Trypanosoma*, bacilli, etc., taken in the manner described.

The thanks of the Meeting were voted to Mr. Moffat for his paper.

Mr. E. F. Law gave a demonstration of the use of colour photography in metallurgy, exhibiting a number of very beautiful slides showing the brilliant colours produced on the polished surfaces of alloys by the varying degrees of oxidation of the different constituents.

The President said they were greatly obliged to Mr. Law for this very interesting exhibition. Many of the slides shown were very beautiful. The thanks of the Society were voted to him unanimously.

Dr. Hebb said they had received a letter from Mr. Macphail, accompanied by a packet of material consisting of Radiolarians for distribution to such Fellows of the Society as wished to have some ; samples could be obtained on application to Mr. Parsons.

On the motion of the President, the thanks of the Society were voted to Messrs. Beck for the loan of the Microscopes for illustrating the subject of Mr. Gordon's paper.

Dr. Hebb reminded the Fellows that at their next ordinary Meeting —which would take place on December 18—it would be necessary to nominate Officers and Council for the ensuing year, and also to elect an auditor of the Society's accounts for 1907, preparatory to the Annual Meeting of the Society on January 15.

The following Instruments, Objects, etc., were exhibited :—

Messrs. R. and J. Beck :—Stained Starch-granules in Autochrome plate; Starch-granules in Autochrome plate, showing deposit of silver under $\frac{1}{4}$-in. objectives.

Mr. C. L. Curties :—The "Nature Study" Microscope and "The Meat Examiner's Microscope."

Mr. J. Inderwick Pigg :—Photomicrographs of the Development of the prothallus and the fern.

Mr. E. Moffat :—New Filter for Agar, Gelatin, etc., and photomicrographs of Trypanosomes, Bacilli, &c., in illustration of his paper on Light Filters for Photomicrography.

Mr. J. Scott Underwood :—Microscope, in silver, by François Watkins.

The Society :—Two old Microscopes, and Lantern slides in illustration of Mr. Nelson's paper on François Watkins' Microscope.

Mr. J. W. Gordon, in illustration of his paper :—1. Mercury globule, to show the bright band edging the under face of the globule. Diameter of globule, $\frac{1}{400}$ in.; objective $\frac{1}{6}$ in.; condenser $\frac{1}{4}$ in.; bright field. 2. Mercury globule, to show the Fresnel rings thrown off from the equatorial zone. The globule is placed slightly aside from the optical axis of the instrument, with the result that the Fresnel rings are compressed on one side and expanded on the opposite side. The eccentricity amounts to about the diameter of the globule, $\frac{1}{250}$ in.; objective, $\frac{1}{4}$ in.; condenser, 1 in.; field darkened by a top stop. 3. Piece of etched tin-foil, lighted only by the top light reflected down upon it by the refracting surface of the objective. Objective, $\frac{1}{12}$ in. oil-immersion. 4. Mercury globule, to show image formed by reflection from the cornea of the observer's eye. Diameter of globule, $\frac{1}{30}$ in.; objective, $\frac{1}{2}$ in.; condenser, 1 in. 5. Mercury globule, to show a number of images formed by the various lenses of the objective. Objective, $\frac{1}{6}$ in.; condenser, $\frac{1}{4}$ in.; diameter of globule, $\frac{1}{250}$ in. 6. Mercury globule, arranged as a test object of resolving power. Diameter of speculum globule, $\frac{1}{77}$ in.; diameter of object globule, $\frac{1}{555}$ in.; measured diameter of black patch, $\frac{1}{600}$ in.; optical tube-length, $7\frac{1}{2}$ in.; equivalent focal length of ocular, $1\frac{1}{4}$ in.; equivalent focal length of objective, $\frac{1}{14}$ in.; diameter of test disk, $\frac{1}{28000}$ in.

Mr. E. F. Law :—Lantern slides showing application of colour photography in metallurgy.

New Fellows.—The following were balloted for and duly elected *Ordinary* Fellows of the Society :—Messrs. Sidney E. Dowdy and John E. Minns.

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ADDENDUM.

THE SOCIETY'S STANDARD EYE-PIECES.

Owing to the notice of the Standardisation of the Eye-pieces being published in the Report of the Council for 1899, it escaped being indexed in the Volume for 1900, and Fellows interested in the subject are requested to enter in the Contents, p. xxxv, and Index, p. 761, after "The Society's Standard 718," 141, 147. These will complete the references to the subject in the Volume for 1900.

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